3

VOL. XVIII • NO. 3 • JULY 1980

DEVELOPMENT DIGEST

The DEVELOPMENT DIGEST is prepared for the Agency for International Development by the National Planning Association, a private, non-profit organization in Washington, D.C.

We would appreciate comments of an editorial nature and suggestions of material for possible inclusion in the DIGEST. Please address:

Editor: DEVELOPMENT DIGEST
National Planning Association
1606 New Hampshire Avenue, N.W.
Washington, D.C. 20009

The material included in the DIGEST adheres faithfully to the sense of the original. It does not, however, indicate omissions, minor editorial changes, etc. For scholarly purposes, the original source should be consulted.

Inclusion of material in the DEVELOPMENT DIGEST does not imply that the opinions and conclusions expressed herein are those of the United States Government or of the National Planing Association.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget June 2, 1966.

For information on how to obtain the DIGEST, see inside back cover.

DEVELOPMENT DIGEST

A quarterly journal of excerpts, summaries, and reprints of current materials on economic and social development

Gordon Donald, Editor; Anthony Pearce-Batten, Associate Editor;
Lowell Shaffer, Digest Secretary
Prepared by the National Planning Association

for

Agency for International Development, U.S. Department of State

CONTENTS

Volume XVIII, Number 3 July 1980

TECHNOLOGY STRATEGY

DEVELOPMENT OF TECHNOLOGY: THE SOUTH KOREAN EXPERIENCE — 3
Hyung-Sup Choi

LICENSING AND SELF-RELIANCE IN THE ANDEAN GROUP — 13
Lynn Krieger Mytelka

INTERMEDIATE TECHNOLOGY IN CHINA'S RURAL INDUSTRIES — 27
Carl Riskin

CASE STUDIES OF TECHNOLOGY SHARING BY U.S. FIRMS IN ALGERIA AND BRAZIL — 45
Jack Berenson

RURAL FINANCE

INVIERNO: AN INNOVATIVE RURAL PROGRAM IN NICARAGUA — 57
Claudio Gonzalez-Vega and Ronald L. Tinnermeier

ASPECTS OF MONEY LENDING IN NORTHERN SUDAN — 71
Martin W. Wilmington

THE PITFALLS OF SPECIALIZED FARM CREDIT INSTITUTIONS IN LOW-INCOME COUNTRIES — 79
J. D. Von Pischke

FINANCING RURAL NON-FARM ENTERPRISES IN LOW-INCOME COUNTRIES — 92
Richard L. Meyer

MICROBIOLOGY

MICROBIOLOGICAL SCIENCE FOR DEVELOPMENT 103
Carl-Gören Hedén

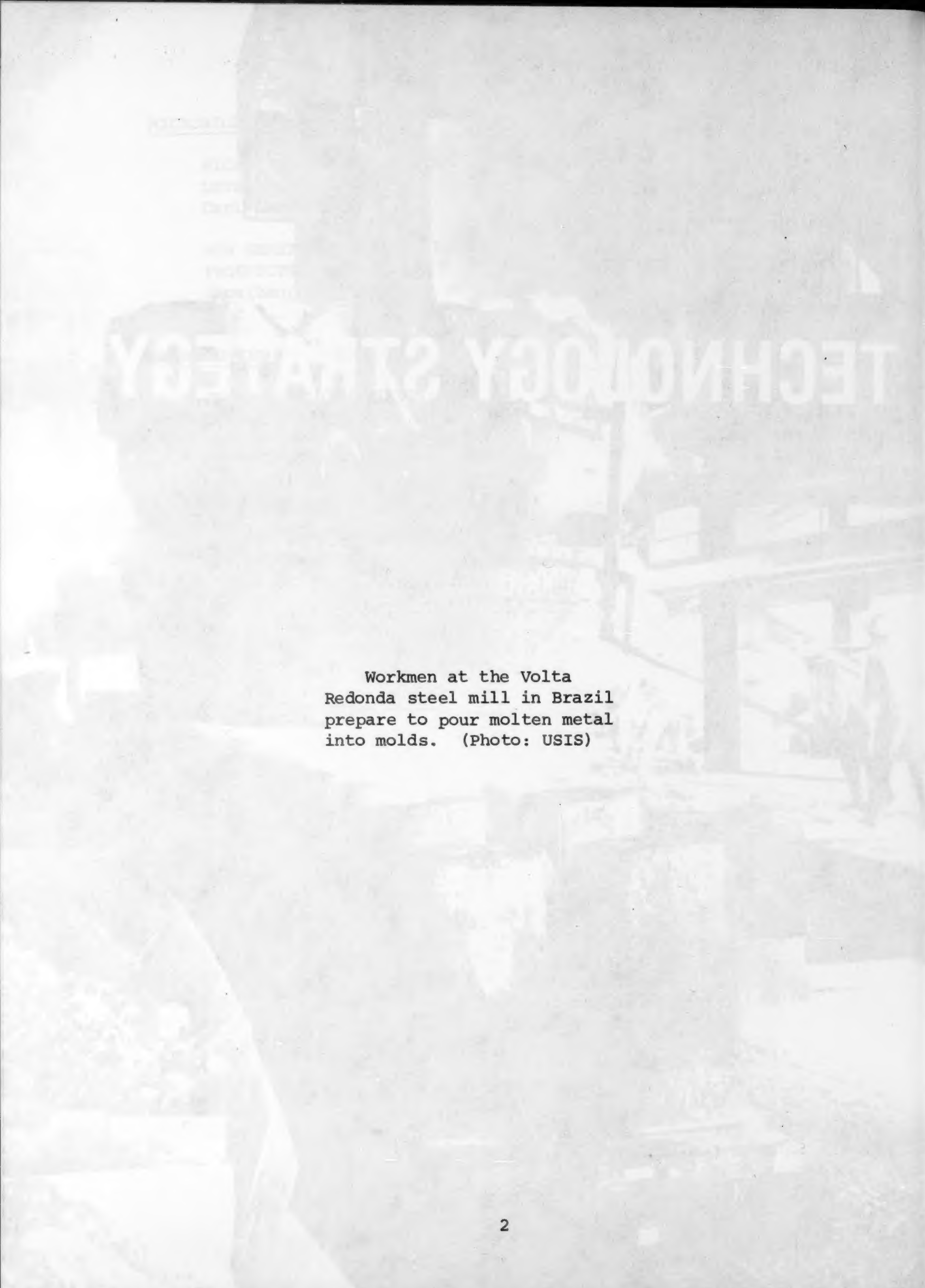
NEW GENETIC TECHNOLOGIES: PROSPECTS AND HAZARDS 112
Jonathan King

BOOK REVIEW

THE BRANDT COMMISSION REPORT 119
Anthony Pearce-Batten

(Unless otherwise indicated
currency is expressed in U.S. dollars)

TECHNOLOGY STRATEGY



Workmen at the Volta Redonda steel mill in Brazil prepare to pour molten metal into molds. (Photo: USIS)

Development of Technology: The South Korean Experience

Hyung-Sup Choi

[South Korea's great success in industrialization in the 1960s and 1970s resulted in part from labor-intensive export industries and low-cost (but skillful) labor. At the same time operation of increasingly sophisticated methods in "leading industries" and an intensive educational drive have markedly raised the nation's capabilities and self-reliance. Less publicized but highly important in the growth process has been the upgrading of technology in rural areas.]

Perhaps more significant than the present array of fantastic new technologies that have sent man to the moon is the emergence of new perceptions about the role of technology in society. For a long time technology was viewed as a common good having only positive value; it was sought after and often unconditionally accepted and praised. But more recent experiences in the development and deployment of technologies give evidence that technology does not always fulfill its purported objectives. We have learned that technology is no more and no less than one important means to many different ends.

Some of the "leading industrial sectors" in a developing country are geared primarily toward breaking the inertia of underdevelopment. They introduce technologies which are quite advanced relative to the country's absorptive capacity. But the "feeder" industries that support these leading sectors do not necessarily require such advanced technology. It is therefore desirable to look at development from both the national and the local points of view, so that production plans involving both leading and feeder industries can be realized.

Dr. Choi is President,
Korea Science and Engineering
Foundation, Seoul, South Korea

Industrial Development in South Korea

The following statistics give some idea of what conditions were like in Korea around 1959-61, the period preceding the launching of the country's industrialization effort under the First Five-Year Economic Development Plan. First, Korea's GNP growth rate averaged 3.3 percent per year, and population growth was 2.9 percent. The per capita income was under $100; 65 percent of the work force was in primary industries, while secondary industries (mining and manufacturing) employed only 6.9 percent. In terms of per capita output, using an index of 1.0 for the national average, primary industries registered 0.65 and secondary industries 2.60. The domestic savings ratio to GNP was only 3 percent. The Korean economy was from the beginning an open one; this was necessary to obtain foreign investments. On the whole, then, Korea offered a perfect example of an underdeveloped, stagnant economy.

Initially, Korea opted to develop light, labor-intensive industries by absorbing the labor force from the primary sector. The effective demand for industrial products in the primary sector was all too slight, and it was necessary to look elsewhere in search of capital, markets, and technology. Instead of initiating a pattern of import substitution to be followed by export development, the two were undertaken almost simultaneously, particularly when the first five-year plan went into effect. The apparent success of this bold approach can be attributed to several factors: (1) the capacity of the labor force to deal with technologies which were relatively sophisticated; (2) close trade relations with the United States and Japan, both of which are big markets; (3) full exploitation of the technical advantage of being latecomers in industrialization; and (4) the capacity to adapt to the international economic environment -- a capacity that was actively supported by the government through the creation of a favorable climate for foreign investment.

The most conspicuous constraints on the scheme for rapid industrialization were deficiencies in the social service sectors. The infrastructure for industrial development was very poor, and the government placed greatest emphasis on the building of roads and ports, communications, and other essentials to development, including expanded educational facilities, particularly for technical training. About 50 percent of the total foreign capital in Korea, as well as over 70 percent of the total public loan funds from overseas, were spent on infrastructure.

During the first five-year plan (1962-1966), there was considerable debate in the course of choosing an appropriate technology. The essential criterion was that the choice of technology had to fit the scale of a project. For instance, the construction of an

innovative, integrated iron and steel plant with an annual production capacity of less than 400,000 tons was contemplated. This, however, was less than the optimum size required for the introduction of modern production methods. Since it was virtually impossible to set up an efficient, integrated operation, the establishment of such a plant was deferred until the second five-year plan, when a plant could be established with a capacity sufficient to justify, for instance, a tandem rolling mill. The introduction of the L.D. converter was in itself a breakthrough for those who had experience only with open hearth or electric furnaces. But it was necessary to wait another several years before a highly sophisticated continuous casting mill could be added to the steel-making plant, and before sufficient experience had been acquired in the operation and maintenance of conventional methods.

The second Five-Year Economic Development Plan (1967-1971) placed emphasis on initiating the "lead sectors" approach and pushed forward with the development of basic chemical industries (such as fertilizers, cement, and petro-chemicals) as well as the iron and steel industry. What was attempted through these sectors was the initiation of a growth momentum that would make itself felt within all Korean industry. These industries are highly capital-intensive and need a huge infrastructure which has to be supported by the government, but they are essential to the foundation upon which the high-linkage industries can be built. In formulating the second five-year plan, a series of bold quantitative tools for constructing development models was introduced. These models were most important in articulating Korea's socio-economic goals, identifying potential industrial growth patterns and major constraints in reaching those goals, and for formulating investment programs.

The idea behind the "lead sectors" approach, along with the use of foreign experts, was to allow greater latitude for debate on the plan so that a defensible strategy would necessarily follow. It is noteworthy that the experts often turned out to be too conservative at both the micro- and macro-planning levels. The dynamism of a developing-country economy -- if it ever does achieve real momentum -- is difficult for the experts to predict. Excessive conservatism can be very troublesome if it occurs in the planning for a key sector, because the forward motion of the whole effort may be brought to a complete halt. Becoming overly optimistic can also be troublesome, however, since it may result in tying up non-productive capital in excess capacity. Thus, one pressing question in developing lead-sector industries was whether or not they could operate at full or at least near capacity. It was found that the range of choice was extremely small because the cost of capital for these industries, which for the most part originated abroad, was very much higher than for the advanced countries. Recognition of this hard fact of life had much to do with the makeup of any industrial project.

The Third Five-Year Economic Development Plan (1972-1976) followed more or less the same direction as the earlier ones but with greater economies of scale in agriculture and social services, capitalizing on the previous experiences of the advanced countries and the improved capacity of the home country itself. This orientation necessitated the introduction of unprecedented numbers of newer and higher-level technologies into Korean industry. The decision was irreversible insofar as scientific and technological development were concerned: it was an issue of survival or extinction in ever-increasing international competition. Korea's experience in the past decade, particularly with reference to the relationship between commodity exports and royalty payments for foreign technologies, indicates that a close positive correlation exists between the two: an adequate supply of appropriate technologies is the essential factor in enabling industry to produce the goods and services demanded in international markets.

Korea's science and technology development policy today hinges on the proper selection, assimilation, and adaptation of imported technologies. Throughout the first development periods, foreign technologies were often accepted along with the inflow of capital, largely because of the strongly felt need for foreign capital. (Statistics on technological agreements <u>per se</u> tend to underestimate the amount of imported technology.) The range of technological choices was often limited, and technology itself was treated as though it were only of secondary importance. But that situation has changed. The specific need for particular technologies, as distinguished from capital, has been recognized. The achievement of a comparative advantage which relies heavily on low labor costs and the use of manual workers is untenable in the long haul. For many developing countries, the day for achieving a better balance in the employment of manual and highly skilled workers should not be in the distant future.

The three successive five-year economic development plans culminated in success beyond our expectations. GNP growth averaged 10 percent per annum in real terms. The manufacturing sector alone attained, on the average, a 20 percent growth rate per annum. Exports, 90 percent of which consisted of manufactured goods, amounted to (U.S.) $8 billion in 1976 compared to $55 million in 1962, increasing approximately 150-fold in 15 years. By the time the Fourth Five-Year Plan ends in 1981, it is envisaged (with some optimism) that the Korean GNP will reach $58.7 billion -- $1,512 per capita. The export target for 1981 is set at $14.2 billion in 1975 constant prices, representing an annual growth rate of 16 percent after correcting for inflation.

Developing an Infrastructure for Technology

Depending on a host of problems, such as the lack of institutional frameworks within which people can function, the lack of legal bases for providing incentives to develop technology, and most of all the lack of qualified people, various approaches can be devised (perhaps differing from country to country) for developing appropriate infrastructures conducive to the development of technology.

It has been said that the development of technology within a developing country is, for all practical purposes, out of the question. It is often asserted that any need for sophisticated technologies can easily be met through the transfer of technology from developed countries, as though it could simply be picked off a shelf. This kind of thinking is not without some justification, but it grossly oversimplifies to the point of collectively condemning what in fact may be worthwhile, necessary, and even noble initiatives on the part of the developing countries. A pressing need to possess indigenous sources of technological development in tune with national requirements is widely felt in the developing countries. One of many formidable questions that need to be addressed is: What kind of technology should a society seek to develop?

The literature on appropriate technology is replete with elaborate treatises on the attributes of technology, but there is less on the attributes of development tasks themselves, which cannot simply be translated into terms of employment or income distribution no matter how pivotal their importance. It is not difficult to achieve a consensus among people of different backgrounds that the appropriateness of the technology depends to a great degree on needs and capabilities. We can further conclude that needs must be identified *before* formulation of any plan for technological development. The pivotal problems are how to ascertain needs, and how to assess latent capabilities, so that they can be translated into development programs. These tasks are most difficult for developing countries, since such capabilities are often inadequate or even lacking. It is especially in this area that international cooperation should play a complementary role if any real progress is to be made.

The appropriateness of technology is often measured in terms of the labor/capital requirement ratio, the level of requisite labor, and the necessary material input. These considerations stem from the assumption that technology is to be chosen only *after* goals have been delineated. There is nothing wrong in doing so, but it fails to take note of another vitally important role that technology should play in the process through which goals are defined. The mere assessment of the appropriateness of the technology, using con-

ventional yardsticks, often fails to take into consideration various other important factors, such as a developing country's absorptive capacity, which depends on many institutional, legal, cultural, environmental, and even ecological factors. Perhaps the biggest problem facing developing countries with respect to appropriate technology is that of establishing harmony between rapidly rising aspirations and the slowness of progress. The cost to the developing countries -- both in political and economic terms -- of exercising a degree of patience rather than allowing rapid growth to skew development into the lead sector will vary from one context to the next. In all contexts, however, the attempt to balance immediate needs against long-term goals requires political will and sound leadership that goes beyond technical considerations.

Korea's creation of an institutional framework was comprehensive, including, among other institutions: (1) the Ministry of Science and Technology (MOST) established in 1967 as the central planning, coordinating and promotional body in the government; (2) the Korea Institute of Science and Technology (KIST), established in 1966 as an autonomous, multidisciplinary, industrial research institute chartered as a contract research organization; (3) the Korea Advanced Institute of Science (KAIS), founded in 1971 as an autonomous institution supported chiefly by the Ministry of Science and Technology, with the mission of training high-caliber professionals in selected applied sciences and engineering; and (4) a great number of vocational training institutes and technical high schools to meet the rapidly rising demand for skilled workers and technicians.

The new Ministry of Science and Technology spearheaded the enactment of several laws of importance for the development of science and technology, including: (1) The Science and Technology Advancement Law of 1967, which defines the basic commitment of the government to support science and technology and to provide policy leadership; (2) The 1972 Law for the Promotion of Technology Development, which, among other things, provides financial incentives to private industries for technology development; (3) The Engineering Services Promotion Law of 1973, which promotes local engineering firms by assuring markets on the one hand and performance standards on the other; (4) The National Technical Qualification Law of 1973, which, through a system of examinations and certifications, promotes the abilities and professional status of those in technical fields; (5) The Assistance Law for Designated Research Organizations of 1973, which provides legal, financial, and fiscal incentives for research institutes in specialized fields on which the government and private industry place particular emphasis (e.g., shipbuilding, electronics, communications, mechanical and materials engineering, and energy and related areas); and (6) The Law for the Korea Science Engineering Foundation of 1976, which provides a legal basis for the

Foundation to act as the prime agent for strengthening research (mainly university-based research) in basic and applied sciences as well as engineering, and to facilitate more rapid application of science and engineering to national needs.

The Korea Institute of Science and Technology (KIST) was brought into being to bolster the industrial sector, particularly in areas emphasized by the national economic development plan, by eliminating bottlenecks that hinder further growth. The Institute was made a contract research organization -- to make researchers problem-oriented and to help make underwriters of R&D aware of the importance of its results.

Before it undertook research of any kind, KIST carried out a comprehensive study to ascertain the actual needs of Korean industry. A study was made of 600 industrial plants and related organizations covering 25 industrial sectors. This study took eight months to complete and involved 80 specialists, 23 of whom were brought from overseas. The survey helped to identify the main areas of concentration for the Institute during its initial period of operation. Studies similar to this initial comprehensive survey are carried out periodically to ascertain industry's ever-changing requirements and to maintain the Institute's capability to solve them. Among the operations set up within the Institute were: (1) a project development department to promote the concept of scientific research among industrial firms and to help industry formulate questions to ask the Institute, (2) a cost accounting system to compare input with performance, and (3) the establishment of a large endowment fund to enable the Institute to undertake long-term research for which no particular client could easily be found. To avoid the rigidity inherent in departmentalization, a multidisciplinary approach was emphasized throughout the Institute.

As industry grew, its technological requirements increased in level and diversity. Some of the Institute's laboratories, such as those in shipbuilding and petrochemicals, were no longer able to render the necessary technical support to their industries. An independent research organization specific to each industry and problem area thus became necessary. Creating completely new organizations would have been a formidable task, so some of KIST's existing laboratories were spun off the mother institute. Thus, they inherited not only the knowledge that had already been accumulated, but also a workable and working management system and philosophy, which all too often are missing or amorphous in a new organization.

The vast importance of industrial research has only recently been recognized. It not only provides support for economic develop-

ment, but, even more importantly, helps create the framework within which economic development strategies are formulated. Industrial research is essential to the realization of a nation's industrialization goals, and, if properly carried out, can help in setting reasonable and feasible goals. Korea has made substantial gains, through much trial and error, in improving its scientific and technical capabilities, improving administration and support systems, and increasing as well as orienting R&D investment. The total effort was intended to change the economy from a simple labor-intensive to a technology-intensive, and ultimately skill-intensive, structure. In other words, the effort was designed to accelerate the transformation of Korea's science and technology infrastructure from a supporting role in national economic development to a leadership role in creating a technologically self-reliant economy in Korea by 1980.

Transfer of Technology Within Countries: A Relatively Unexplored Frontier

While international technology transfer has been much in the limelight, surprisingly little attention has been given to the crucially important transfers between urban and rural areas, between industry and agriculture, and between business firms of varying sizes. Without a means for active transfer of technology *within* countries, development efforts are futile. The idea is not new, but it probably has not been pursued widely or conscientiously enough. At the macro-level -- for instance, in trying to bridge the gap between the urban and rural economies -- probably every developing country has tried some type of deliberately planned program of internal technology transfer; Korea's experience parallels some of these efforts in objective and perhaps in approach as well.

Korea's massive program, called Saemaul Undong, which means new community movement, was undertaken at the national level and involved myriad programs, ranging from digging or improving sewage ditches to applying new farming techniques. The program also aimed at bringing about selective rural industrialization -- through the offer of incentives -- in the belief that the rural labor force could make a contribution to the development of industry. It became apparent, however, that it would take more than an abundant labor force to make industrialization of rural areas feasible. Many inherent difficulties quickly became obvious, making it necessary to readjust the time schedule for locating industry in rural areas. Upgrading living conditions and introducing means of earning supplementary income was made a major objective. The government channeled support to about 20,000 villages, with the support varying according to the extent of self-help displayed and the nature of the jobs to be done. For the last two consecutive years, rural house-

hold income in Korea has slightly surpassed that of urban households, perhaps for the first time in modern history. Many attribute that result to this program.

Dr. Vincent Brandt, an American anthropologist who has been studying rural Korea for some years, finds that rural development gained substantial momentum since the early 1970s for the following reasons. First, there were profound and irreversible modernizing changes in rural attitudes and in the operation of village institutions, particularly after the successful land reforms of the early 1950s. Second, government efforts placed less emphasis on farmers' psychological motivations and more on furnishing essential assistance to agriculture in terms of credit and technical advice, and by providing better organizational linkages between the villages and the national economy. Third, improved communications and transportation have played a part in this progress, as have movements of population (e.g., the thousands of people who returned to their villages after military service and others who have moved to urban areas have all established contact points between urban and rural areas). A fourth factor was the transformation of local bureaucracies, which used to be more resistant to innovation than the farmers. This change was due mainly to an unswerving government commitment originating with the chief of state.

Once these changes were under way in Korea, many scientists and professors working in science and engineering realized that they might have something useful to contribute to rural development as volunteers -- even in the little time available to them for such an activity. The Federation of Scientific Societies set up a small secretariat to coordinate such activities, initially with the token participation of about one hundred people. In only two years this has grown into a technical service corps with a network of eight provincial secretariats.

Much to the surprise of the participants, these professionals found many problems for whose solution their expertise was inadequate. At the same time there were many other problems with which they could offer immediate help. Designing a concrete bridge across a creek, for example, was one day's homework for a college-level civil engineering student. An even more important result of these interfaces of scientists and engineers with people at the grassroots level was the two-way learning process that occurred. The rural people learned much from having presented their problems to academicians who, in turn, obtained invaluable insights on how education should prepare people to solve practical problems. It was heartwarming to see how people with such different social and educational backgrounds were able to communicate with each other to solve problems.

In the final analysis, then, the establishment of an infrastructure conducive to innovation should receive the highest priority at the national level. The government's role is pivotal in the accomplishment of this task. One lesson learned from this experience is that the pool of knowledge and the existing state of the arts can be applied to solve a broad range of rural problems -- provided that the agents (not necessarily agencies) are motivated to work with people at the grassroots, even when they have only limited time to devote to such work. Although there is no remuneration for services, the involvement of academics and laymen alike has increased as the program has progressed. Perhaps the most important result of the program is increased awareness of the need for technology transfer within countries -- and of the immense economic as well as moral benefits that accrue from it.

Conclusions

Korea's particular experiences suggest several conclusions that can be made about the developmental process in general. First, for countries that suffer from the vicious cycle of economic underdevelopment, it is imperative, initially, to pursue development in some leading sectors with a daring mix of technologies and entrepreneurship. Second, a massive campaign to mobilize in-country talent and bring it to bear on problems at the grassroots level, be they agricultural or industrial, must be undertaken. Third, the developing countries cannot allow themselves to be swayed by the prevalent notion that the generation of technology in developing countries is uneconomical, if not impossible. On the contrary, there appear to be vast possibilities, even an absolute need, in the developing countries for the generation of technologies by those countries themselves.

[Extracted with permission from Chapter 8 of Mobilizing Technology for Development, edited by Jairam Ramesh and Charles Weiss, Jr., New York: Praeger Publishers, for the International Institute for Environment and Development, and the Overseas Development Council, 1979.

Licensing and Self-Reliance In the Andean Group

Lynn Krieger Mytelka

[The objective of technological self-reliance means that a nation aims to acquire the capacity to assimilate and later to improve on imported technologies. A study of firms in two modern industries in three Andean Group countries indicates some of the factors conducive to growth in self-reliance.]

The Route to Self-Reliance in Technology

This paper explores the extent to which licensing promotes technology transfer and future technological self-reliance in 47 metal-working and 43 chemical firms located in Peru, Ecuador and Colombia. By definition a technology transfer implies the assimilation of imported technology by a recipient firm. In time, the firm may also develop the in-house capabilities to adapt, extend and perhaps improve upon the imported technology. All these capabilities are necessary components of a strategy of technological self-reliance.

A strategy of technological self-reliance seeks to accomplish two basic objectives. The first is to maximize the developing country's choices through increased knowledge and capability. This means developing the evaluative skills which permit appropriate choices of technique, as well as bargaining skills which make it possible to obtain improved terms for technology imports; and the research and development (R & D) skills which enable the firm to "depackage" technology, purchase components from least-cost suppliers, develop elements of the package themselves or extend the technology in order to

The author is a Professor of Political Science at Carleton University, Ottawa, Canada.

diversify product lines. Historically, R & D in large, multinational firms has been biased towards innovation related to the conditions which prevailed in their principal markets in the industrialized countries of the world. Therefore, a strategy of technological self-reliance for developing countries must seek to foster local research and development into products and processes appropriate to domestic needs, resources, incomes and tastes -- the second major objective.

Most Third World countries have neither the technological base nor the structure of demand for technology to make the assimilation of imported technology and its adaptation, extension and improvement a quick or easy process. Thus, it is argued, in order to maximize the likelihood of a real technology transfer, recipient firms within this environment will have to consciously engage in activities which permit "learning by doing" -- that is, to seize every opportunity to solve problems associated with the choices of technique, of machinery and machinery suppliers, and of the very products to produce. In this way they will develop the in-house capability to assimilate imported technology. To move beyond assimilation towards future technological self-reliance, recipient firms would then have to embark on a process of "technological apprenticeship", that is, a process stressing the adaptation and marginal improvement of products and/or known techniques of production (rather than the development of new products and/or productive techniques). This presupposes the creation of in-house research and development capabilities. Whether this process of technological apprenticeship will lead to major indigenous innovations is not at issue here; a strategy for technological self-reliance is not intended to be a blueprint for autarky.

The Sample of Andean Pact Firms

Initially the project from which the data presented here were derived was designed to explore the impact of Andean efforts to regulate technology transfer and direct foreign investment through Andean Group Decision 24 in 1971 (see Development Digest, January 1974, p. 81). The 90 firms selected for inclusion in this study, therefore, do not constitute a random sample of firms in the Andean region; instead they represent nearly all the cases in 10 product sectors within the chemical and metalworking industries -- two industries of considerable significance for Andean industrial programming activities -- in those three Andean countries where relative political stability ensured no major discontinuities in the implementation of Decision 24 during the first five years following its adoption. While the study represents an accurate picture of relationships in these product lines and for these particular countries, generalizing these findings to other industries or countries would be inappropriate.

Of the 90 firms, 20 were Ecuadorian, 37 Colombian and 33 Peruvian. By 1975, 44% of the chemical firms and 32% of the metal-working firms had been in production for more than 15 years. Nineteen percent of the firms in the survey were foreign-owned corporations, 9% were state corporations, a further 9% were mixed-private corporations, 39% were nationally-owned corporations and 24% were nationally-owned family firms. Table 1 explains this classification and provides data on the firms by ownership structure and product sector.

Table 1. *Product sector by ownership structure* of the firm*

Product sector	Ownership structure						
	Foreign corps	State sector Mixed	State sector Nat'l	Mixed pvt.	Nat'l pvt. corp	Nat'l family	Total
Fibres	2	2	0	0	0	0	4
Plastics	5	0	2	3	3	1	14
Paints	2	0	0	1	3	6	12
Soaps	0	1	0	0	3	2	6
Chemicals	3	0	1	0	2	1	7
Total chemicals	12	3	3	4	11	10	43
% of chem. indus.	28%	7%	7%	9%	26%	23%	100%
Electrical machinery	3	0	0	1	2	1	7
Industrial machinery	0	0	0	0	10	2	12
Foundry parts	1	0	0	1	4	3	9
Tools	1	1	0	1	5	2	10
Finished goods**	0	0	1	1	3	4	9
Total metal	5	1	1	4	24	12	47
% of metal indus.	11%	2%	2%	8.5%	51%	25.5%	100%
TOTAL ALL SECTORS	17	4	4	8	35	22	90
% all sectors	19%	4.5%	4.5%	9%	39%	24%	100%

*This classification is based on Decision 24 of the Andean Group. Foreign corporations are either wholly-owned subsidiaries or firms in which less than 20% of the shares are held by nationals. State-controlled firms are those in which the state wholly owns the corporation or owns a minimum of 30% of the shares (generally along with a foreign multinational corporation) but exercises effective control over crucial planning decisions within the firm. Mixed private corporations are firms in which nationals own between 51 and 80% of the shares. In both national corporations and family firms nationals own 80% or more of the shares but in the case of the latter the firms are not public corporations.

**Includes airplanes, toys and other finished metalworking products. These firms were selected because they produce a product covered by the metalwork programme but often did not produce this product as their major product. The above classification is based on the major product of the firm defined in terms of the total value of production.

The 82 firms which supplied data on the total capital of their firm in 1974 were divided into thirds and categorized as small, medium and large. Ecuadorian firms in this survey tended to be small (29%) or medium sized (47%); 45% of the Ecuadorian firms were family firms, and 72% of the family firms in the survey as a whole were small. The reverse situation pertained in Colombia where 54%

of the firms were large, 20% medium and only 26% small. Some 32% of the Colombian firms in these ten product sectors, however, were foreign-owned and 63% of the foreign firms in the survey as a whole were large. Peruvian firms approximated the Ecuadorian pattern -- 43% small; 40% medium; 17% large -- but differed in that the stringent application of divestment regulations during the Velasco period had eliminated the wholly foreign-owned firm from these product lines by 1975, the year in which this survey was undertaken.

Licensing was the most common means of obtaining industrial technology in these metal-working and chemical firms. Of the 90 firms in the survey, 49 (54%) license the technology for one or more of their major products. The remainder acquire whatever technology they need, either autonomously through the experience of their personnel (29%), or through non-negotiated means such as: copying imported products (8%, all metalworking firms), direct purchase of machinery and processes (3%), or informational diffusion through journals and professional meetings (6%).

The Analysis

As Table 1 illustrates, the structure of ownership in these Andean firms and the product sectors in which they are located were closely related. Foreign firms in particular clustered in industrial sectors noted for the complexity and volatility of their technologies, sectors in which their technological advantage permits the exaction of monopoly rents. Nationally-owned firms, on the other hand, were dominant in the metalworking industry and in the simpler, more stable technological sectors of the chemical industry.

Ownership structure, product sector and firm size, moreover, correlated highly with the decision to license technology. Using a stepwise discriminant function analysis, only these three variables met the criterion values and were included in the single function discriminating between those firms which license and those which acquire their technology by other means. The standardized discriminant function coefficients of 0.51 for size, 0.42 for product sector and 0.41 for ownership structure were remarkably close, indicating the relatively equal importance of these three factors in relationship to the decision to license. Size, however, interacted with ownership structure (Yule's Q=.785); no foreign or mixed firm was small, and only 9 of the 57 national firms were large. Ownership structure alone correlated highly with the source of technology (Q=.755), suggesting that the high correlation between size and source of technology was simply derivative from ownership. From Table 2, moreover, it is evident that foreign and mixed corporations overwhelmingly licensed their technology, even for products like paints, foundry parts, tools -- where the technology was simple and stable enough

to expect that the firm could develop its own methods. From this portion of the analysis, therefore, it appeared the ownership structure was a pivotal variable influencing both the choice of product and the need to license.

This analysis enabled us to distinguish between foreign and mixed corporations, on the one hand, and state and national firms on the other. But it did not help to explain the behavior of the latter with respect to the decision to license technology. In his study of 123 Argentinian firms, Francisco Sercovich suggested that licensing permits national firms to enter oligopolistic markets in which competition is structured by the standards set through foreign imports. Licensing thus reinforces the size advantage of the firm, making competition and growth possible. In this survey, therefore, the choice of products should represent the "quality segment" of the market in which the firm chooses to compete.

Table 2. *Ownership structure, product sector and source of technology*

	Foreign		*State*		*Mixed Pvt.*		*National*	
	Lic.	Other	Lic.	Other	Lic.	Other	Lic.	Other
Fibres	2	0	2	0	0	0	0	0
Plastics	4	1	2	0	2	1	4	0
Paints	1	1	0	0	1	0	4	5
Soaps	0	0	1	0	0	0	3	2
Chemicals	2	1	1	0	0	0	0	3
CHEMICAL	9	3	6	0	3	1	11	10
% of ownership category	75%	25%	100%	0%	75%	25%	52%	48%
Elect. machinery	3	0	0	0	1	0	2	1
Industrial machinery	0	0	0	0	0	0	5	7
Foundry parts	1	0	0	0	1	0	1	6
Tools	1	0	0	1	1	0	1	6
Finished goods	0	0	1	0	0	1	2	5
METALWORKING	5	0	1	1	3	1	11	25
% of ownership category	100%	0%	50%	50%	75%	25%	31%	69%
TOTAL	14	3	7	1	6	2	22	35
% of ownership category	82.4%	17.6%	87.5%	12.5%	75%	25%	39%	61%

N = 90

Data on the explanations offered by firm managers in our sample for their decision to license provides some evidence for Sercovich's hypothesis, and demonstrates that neither cost considerations nor complexity are paramount. Rather, as Table 3 reveals, 51% of the firms gave "brand-name" considerations as one of the reasons for licensing, thus implying entry into a "quality segment" of the

market in which standards had been set by foreign firms and foreign imports. It is also apparent from this table that for many of the firms, including many nationally-owned firms, the decision to license technology has not (as in Japan) provided the firm with a means to diversify, to fulfill the firm's expanding horizons and its growing ability to choose technology appropriate to the realization of its goals and to assimilate imported technology, adapt and extend it. Rather, the decision to license seems to have represented an unconscious choice to forego technological self-reliance from the outset. To the 51% of firms citing "brand-name" as a reason for licensing technology must be added the 30% citing "prior relationship to the technology supplier" as a factor. Indeed 12 of the 47 firms responding to this question gave no other reason but "brand name" and "prior relationship" as explanations for the decision to license. In most of these cases neither the technology nor the supplier was actually chosen by the licensor. Rather the licensor was chosen by the foreign firm, with the local firm playing a completely passive role -- one unlikely to stimulate the learning experiences necessary for technological self-reliance.

Table 3. *Stated reasons* technology was acquired through licensing*

	Complexity+	Prior Rel 'n‡	Brand-name§	Cheapness‖	Other¶	Total
Total number of responses per reason cited	25	14	27	12	8	86
Percent of total number of responses	29	16	31	14	9	99%
Number of firms citing this factor as one reason	22	14	24	12	8	47**
Percent of firms citing this factor as a % of 47 firms responding	47	30	51	26	17	--

*Each firm was permitted up to three reasons.

+'Complexity of the technology' and 'the technology is so complex that only a few firms in the world have it' were regrouped under 'complexity'.

‡Prior relationship to the technology supplier either as a subsidiary of the foreign firm which would supply the technology or as a distributor for that firm's products.

§Regrouped under 'Brand-name' were responses such as 'the named product is known for its quality', 'for its brand-name' and 'need to compete with other firms with known brand-names'

‖Includes 'because it was the cheaper alternative to producing the technology themselves'

¶ Includes 'because of advantageous bargaining conditions' such as reduced costs, few restrictions.

**47 of the 49 firms which licensed their technology gave an explanation for the decision to license.

The ramifications of licensing for future technological self-reliance became evident when licensing was correlated with the managers' claims to possess the "ability to develop new product technology". Managers of firms in the survey were asked to discuss their firm's future development plans. Those managers who said their firms intended to introduce new or allied products within the next 5 years were then asked whether their firm could develop the technology it would need for these products on its own. Developing the technology was understood to include extending or modifying existing technology, copying technology embodied in machinery, or acquiring the necessary technological knowledge from books or journals. Table 4 provides data on these responses. Only 32% of the managers of those 53 firms in which new or allied products would be introduced said their firm could develop all the technology needed for these new products on their own. Twenty-five percent felt that their firms might be able to develop technology for some of these future products; 43% said they could not develop the technology on their own for any of these products but would import it. Given the uncertainty expressed by those who felt their firms might be able to develop some new product technology on their own, 'some' and 'no' answers were put into a single negative category for statistical analysis.

From Table 4 it is apparent that there is a high correlation between licensing and "the inability to develop technology for new or allied products which the firm plans to introduce in the immediate

Table 4. *The correlates of technology dependence*

Ability to develop new product technology	Source of Technology: Licence	Other	Total
Yes	1(3%)	16(73%)	17(32%)
No	30(97%)	6(27%)	36(68%)
	31	32	53
		Yule's Q =	0.975

	Product Sector: Chemical Sector, Licence	Chemical Sector, Other	Metalworking Sector, Licence	Metalworking Sector, Other
Yes	0	7(88%)	1(8%)	9(60%)
No	18(100%)	1(12%)	11(92%)	6(40%)
	18	8	12	15

	Ownership Structure: Foreign, State and Mixed Private, Licence	Foreign, State and Mixed Private, Other	Nat'l Corps and Family Firms, Licence	Nat'l Corps and Family Firms, Other
Yes	0	1(50%)	1(6%)	15(75%)
No	15(100%)	1(50%)	15(94%)	5(25%)
	15	2	16	20

future", which defines "technological dependence". Ninety-seven percent of the firms which license their technology responded 'no', whereas 73% of the firms which obtained their technology by other means respond 'yes' to this question.

This relationship, however, must be understood within the context of ownership structure and product sector. From the data on product sectors and their relationship to 'technological dependence' it can be seen that firms in the chemical industry, and especially those in high technology sectors such as synthetic fibers and plastics, are much less likely to develop their own new product technology than are firms in the metalworking sector. Only among firms in the low technology sectors -- paints, chemicals, foundry parts and machine tools -- do we find that 50% or better feel they can develop all technology for new or allied products they plan to introduce on their own.

Looked at in terms of ownership structure, the distribution of responses revealed that no state corporation, no mixed private firm, and only one foreign firm was able to develop all new product technology on its own. The exception was a foreign firm located in the chemical sector which did not license its technology. Only among national firms do we find that as many as 44% of the managers expressed the belief that their firms could develop new product technology, and there again the most important factor seemed to be whether the national firm licensed its technology or not. Of the 16 national firms which said they could develop new product technology, 15 (94%) obtained their technology by means other than licensing; of the 14 firms which could not produce any new product technology, 71% presently license their technology.

Table 4 summarizes these results and points to the central role of licensing in perpetuating technological dependence. Neither the independent direct effect of product sector nor of ownership structure was large. This relationship was also confirmed through discriminant function analysis. The standardized discriminant function coefficient for 'source of technology' was 0.834, over two and a half times larger than the coefficients for ownership (0.299) and age of the firm (0.264). Size and product sector were lower in correlation.

Questions of Causality

But how exactly does licensing, even among national private and public firms, 'cause' future technological dependence? Three complementary and reinforcing explanations have been offered in the literature. First, it has been argued, legally binding provisions contained in licensing agreements reduce the firm's incentive to develop technology. Clauses prohibiting exports embodying the

imported technology, for example, deprive the local firm of a marketing incentive which might induce further innovation. Clauses requiring the transfer to the supplier of innovations or improvements obtained through the use of imported technology remove the monetary incentive to undertake research and develop new products or processes. Examinations of licenses have shown that such agreements are replete with restrictive clauses. Decision 24 of the Andean Group was a response to this situation, and following upon its adoption government agencies in each of the Andean countries began to register and review technology contracts with a view to eliminating these restrictive clauses. Some data on the impact of Decision 24 five years after its adoption are now available, but these do not permit a conclusive determination of the extent to which the elimination of restrictive clauses alone has affected the assimilation of imported technology or the development of local R & D capabilities. Certainly the environment becomes more permissive, but merely providing an opportunity does not imply that the opportunity will be seized. Other factors undoubtedly intervene.

One such intervening variable is the psychological impact of licensing on the choice of self-reliance as a goal. Licensing, it is suggested, creates a psychological environment of dependence. Managers become accustomed to rely on imported technology, and incorporate the assumption of technology imports automatically in their future planning. The multinational corporation, moreover, does little to discourage such psychological dependence since it does not favor the growth of potential competitive centers of innovation. This hypothesis has yet to be tested in the Andean context, but it does seem plausible and is consistent with our sample results. Sixteen of the 17 firms (94%) which plan to introduce new or allied products and can develop the technology for these products themselves, not only use their own technology but have already introduced new products in the past. What this suggests is that, at least for these particular firms, the combination of these two factors -- autonomously generated present technology, sustained by the firm's experience with the introduction of new products -- appears to have contributed to the confidence which these managers expressed in their announced intention to introduce new or allied products in the future, and their assessment of the firm's ability to generate new product technology on its own.

Finally, licensing might be a factor inhibiting the development of a capacity to innovate within the firm. This inhibition results from the loss of opportunities to learn about the technology and thus to assimilate it. Firms are thus unprepared to adapt or extend existing technology in order to produce allied products or develop new product technology on their own. Two tests of this hypothesis were made. First, the extent to which the local firm's management

participates in decisions about the choice of imported machinery was analyzed. Second, an attempt was made to assess the extent to which R & D activities of the kind which facilitated assimilation of the imported technology were being undertaken within these firms.

Few of the firms in this survey manufacture their own machinery. When asked the source of machinery imports, 93% (13 firms) of the subsidiaries of foreign firms which responded stated that they had obtained their machinery either directly from their parent or licensor, or from a firm recommended by their parent or licensor. Of the seven state corporations responding to this question, all had obtained their machinery imports from their foreign partner's parent or licensor or from a source recommended by their partner's parent or licensor. Only the mixed private and the national firms predominantly obtained their machinery imports from other sources. Sixty-seven percent of the mixed corporations and 80% of the national firms fell into this category.

Table 5 shows that none of the 14 firms which both license their technology and permit the choice of machinery imports to remain in the hands of the parent or licensor feel able to develop new product technology on their own. By contrast, 13 of the 17 firms (76%) which obtain their technology by means other than licensing and participate actively in the process of choosing machinery imports feel that they are able to develop new product technology on their own. None of the nine firms which license technology but which do participate in the process of choosing machinery imports felt that they could develop new product technology on their own. Participating in the process of choosing machinery imports thus appears to reinforce the self-reliance of firms which presently generate their own technology; but for firms which license, participation in the choice of machinery imports alone does not provide sufficient learning experience to enable the firm to produce its own new product technology in the future. An assessment of the research and development activities of the firms included in

Table 5. Choice of machinery imports, source of technology and technology dependence

Choice of machinery imports	Ability to develop new product technology: YES – Licence	YES – Other	YES – Total	NO – Licence	NO – Other	NO – Total	Total
Parent/licensor related source	0	1	1	14	1	15	16
Other	0	13	13	9	4	13	26
Total	0	14	14	23	5	28	42

this survey suggests other directions in which the state and local firms might move to encourage technological self-reliance.

R and D Within Firms

Of the 90 firms in this survey, only 30 both engage in R & D activities other than quality control, and expend funds on R & D apart from the operating budget of the firm. Breaking these figures down by ownership structure revealed that 67% of the foreign firms and 88% of the mixed private corporations do no R & D at all. Half the state corporations and 44% of the national corporations, on the other hand, do engage in R & D activities and expend funds for them apart from their operating budgets.

Upon further investigation, however, it was discovered that all four state firms which engaged in R & D activities were Peruvian, as were 13 of the 20 national firms which fell into this category. Whereas only 11% of the Ecuadorian firms and 23% of the Colombian firms do R & D, some 60% of the Peruvian firms engaged in research and development activities. It is probable that this high affirmative response rate in Peru reflects the impact of domestic legislation which encourages firms to engage in R & D (or in activities which can be recast as R & D) in order to recuperate the 3% tax on corporate profits used to feed a state fund for technology research. Of the 49 firms which license their technology, 65% do no R & D at all; but of the Peruvian firms which license, most do engage in R & D activities. Indeed all the foreign, state and mixed firms in Peru which do R & D also license their technology, as do six of the 13 national firms. The potential role of the state in inducing R & D activities is thus impressive.

Although these data are not by any means conclusive, simply doing R & D does not appear to have been sufficient to break the very strong link between licensing and technology dependence exhibited by the firms in this survey. Engaging in R & D when the firm presently licenses its technology only slightly reduces the probability of technological dependence. Thus, none of the 17 firms which license and do no R & D felt able to modify or extend existing technology, or to develop entirely new technology on its own for products it wishes to introduce in the future. But only one of the 13 firms which license and engage in R & D felt able to develop its own new product technology.

These results may be a function of the kind of research and development activities being pursued in these firms (see Table 6). Overwhelmingly (44%) the firms in this survey engaged in R & D of the 'product adaptation' type; for many of the respondents this often meant little more than moving a handle to a different location

Table 6. *Type of R & D activity by ownership structure*

	Ownership Structure of the Firm					
	Foreign	State	Mixed	National	Family	Total
Product improvement	1 (7%)	0	1 (14%)	7 (23%)	4 (24%)	13 (18%)
Product adaptation	9 (64%)	2 (50%)	4 (57%)	9 (29%)	8 (47%)	32 (44%)
Vertical integration	1 (7%)	2 (50%)	0	2 (6%)	0	5 (7%)
New product development	2 (14%)	0	1 (14%)	8 (26%)	3 (17%)	14 (19%)
Process modification	1 (7%)	0	1 (14%)	5 (16%)	2 (12%)	9 (12%)
TOTAL	14 (100%)	4 (100%)	7 (100%)	31 (100%)	17 (100%)	73 (100%)

or changing the color of the product. Several of the firms also cited 'vertical integration', that is, increased manufacture of components within the firm, as a major Research and Development activity. Neither 'product adaptation' nor 'vertical integration' of the type described are activities with spillover in terms of building the capabilities necessary to generate future technology. One would not expect, therefore, that firms undertaking these kinds of activities would feel confident of their abilities to develop new product technology in the future. National firms which engaged in 'product improvement', that is quality control or standardization for products they produce with their own technology, and all firms engaging in 'new product development' or 'process modification', on the other hand, can be considered to have embarked upon a process of 'technological apprenticeship'. One would thus expect that those firms engaging in these types of R & D activities would feel more capable of developing their own new product technology in the future.

When the type of R & D activity is correlated with technological dependence, however, the relationship revealed is very weak. Fifty percent of the firms which engage in 'new product development' feel able to develop the technology for future products on their own. Forty-five percent of the firms which engage in 'product adaptation' also responded affirmatively to this question. A lower than expected affirmative response rate is found among firms engaging in 'process modification' and a higher-than-expected affirmative response rate among firms engaging in 'vertical integration'. The data are too scanty to say anything conclusive with respect to the relationship between type of research and development activity and technology dependence. Nevertheless, the fact that 10 of 11 foreign firms (91%) which license their technology also engage in R & D of the less innovative types (product adaptation and vertical integra-

tion), or that five (71%) of the seven national corporations which felt able to develop new product technology in the future also engage in the more innovative types of R & D activity (new product development, product improvement, and process modification), certainly indicates that this line of inquiry deserves further investigation.

Conclusions

In this analysis a close relationship between the ownership of the firm and the products it chooses to produce was established. Ownership structure, it was suggested, was a pivotal variable associated with the decision to license because foreign, but not national, firms licensed their technology even in product sectors where the technology was simple enough to expect the firm to develop its own technology or acquire it through other means. National firms which chose to duplicate a foreign product, however, were impelled to license in order to compete in a 'quality segment' of markets in which standards were set by foreign firms and foreign imports.

Licensing, moreover, was shown to correlate highly with the intention of firms to license new technologies in the future. While legal restrictions and psychological factors undoubtedly affect the relationship between licensing and future technological dependence, a more compelling explanation might lie in the minimal participation of firms which license their technology in activities which could enhance the potential for technological assimilation or adaptation and extension of imported technology. Thus it was suggested that ownership structure and licensing interact with choice of machinery imports and with research and development activities in such a way as to produce a technological dependence syndrome in which opportunities for 'learning by doing' are consistently missed.

The study also uncovered an unexpected pattern of activities among state-controlled corporations in these three countries. While some of the firms were located in intermediate goods industries, many were located in sectors where the technology was complex and volatile and where production was consumer-oriented. In almost all instances this choice of product was such as to necessitate the aquisition of technology from foreign suppliers, and 87% of the state-controlled firms did license their technology. All seven of the state firms which responded to the question concerning choice of machinery had obtained their machinery from their foreign parent (when they were joint ventures) or their foreign licensor, or from a source recommended by their parent or licensor -- thus missing one potential opportunity for 'learning by doing'. State firms in Ecuador and Colombia, where there is no national legislation motivating them to do so, do not engage in research and development; and of the

four Peruvian state-controlled corporations which do engage in R & D, all four are in R & D activities with limited spillover potential for the creation of capacities to generate technology in the future. To those who believe that state-controlled firms will automatically pursue policies of greater technological self-reliance, these results are disappointing.

These data point to certain important areas for choice by national planners. In particular, the choice of products is crucial. If technological self-reliance is to be a major objective, the selection of products for domestic manufacture must be made with a view to maximizing the potential of firms to assimilate and perhaps later to adapt, extend or improve upon the pertinent foreign technology. The appropriateness of these products to the tastes, incomes and needs of the population must also be taken into account, of course. The sectors in which state-controlled firms in this survey were located were obviously not chosen with these factors in mind.

Considerations of appropriate product sectors, of depackaging technology in order to participate in the making of decisions which enhance technological capacity, and of developing R & D activities which facilitate the assimilation of imported technology and the generation of more appropriate technologies must also be assessed by governments when they encourage multinational corporations to locate wholly or majority-owned subsidiaries in their countries, or to enter into joint ventures with local firms. The data contained in this study suggest that only corporations in which 80% of the shares are owned by nationals diverged significantly in their behavior from the foreign and mixed corporations, and followed policies conducive to creation of some potential for technological self-reliance. This puts seriously into question the present policy of divestment as a solution to the problem of technological dependence within the Andean Group.

[Extracted from "Licensing and Technology Dependence in the Andean Group", <u>World Development</u>, Vol. 6, No. 4, April 1978, pp. 447-57. Copyright © Pergamon Press Ltd., Oxford, England.]

Intermediate Technology in China's Rural Industries

Carl Riskin

[China's rural industries, which make extensive use of intermediate technologies, fulfill a number of different functions, some strictly economic and others more socio-political in nature. After a brief history of rural industrial development since 1952, this paper identifies the most important functions, and the main results of Chinese experience. Given China's objectives, its rural industries seem to have been developed in a manner appropriate to existing conditions and to the tasks they were intended to accomplish; but their role is now shifting.]

In an age of remarkable technological feats, it is natural that great stress should be put on the search for technological solutions to the problems of less developed countries. In pursuing technologies suitable to the factor proportions, foreign exchange availabilities and skill levels of developing countries, it must not be forgotten that technology interacts in a complex variety of ways with other components of culture and society, and that these relationships play a role in determining the appropriateness of particular techniques. The history of China's experiences with the search for appropriate technologies is of interest in this connection. Because the Chinese have gone to unusual lengths in developing indigenous and intermediate techniques in industry, their experiences shed light on the complexity of issues affecting the evaluation of such techniques, and also provide some insight into the size and the limits of their potential contributions to accomplishing such targeted objectives as increasing employment and output, reducing capital requirements, and saving foreign exchange.

Dr. Riskin is Professor of Economics at Queens College, City University of New York.

A Brief History of Technical Choice Policy in the PRC

A coherent general approach to industrial development was articulated in China shortly after the establishment of the People's Republic, and was incorporated into the First Five-Year Plan (1953-57, but published only in 1955). According to this approach, while the central government was busy building a modern, large-scale industrial sector to serve as the backbone of the industrialization effort, the various localities (provinces, municipalities, districts and counties) were to undertake an effort of their own. Their task was primarily to produce industrial inputs for agriculture and consumer goods required by the peasantry, and secondarily to serve as adjuncts to the emerging modern industries in the cities.

The technologies to be adopted by the local industries were dictated by a constraint central to the entire approach, viz., that these industries use only such resources as were not required by the modern, large-scale sector. Under no circumstances were they to compete with the modern sector for raw materials, fuels or other inputs. Hence, they were to be confined to waste and scrap materials, second-hand machinery and equipment, small scattered or low-quality ore deposits, and locally available skills and financial resources. The technologies consistent with this constraint were relatively small in scale of output, and relatively labor-intensive. Hence the administrative division of Chinese industry into centrally and locally operated components conformed quite closely to the technological division between relatively large-scale and capital-intensive units on the one hand, and relatively small-scale and labor-intensive ones on the other. A large part of the latter category, strictly speaking, consisted of handicrafts and was under collective (i.e., cooperative) rather than local government jurisdiction.

During this period, the peasantry depended for a major portion of its production and consumption needs upon the local industrial and handicrafts sectors. The First Plan called for most investment in agriculture to be self-financed by the agricultural cooperatives and individual peasant households; local industry and handicrafts were the natural source of the real goods counterparts to local savings. But with its leadership resources stretched thin by a variety of massive economic and social programs of higher priority, the government did not vigorously promote local industrialization at this time, and farm production lagged. The government became aware of these problems by the middle of the First Plan period, and began to encourage greater attention to local industries. In 1957 the central ministries worked out a set of more than 100 designs for small-scale plants capable of being maintained and operated locally. Their importance was to emerge only later, for shortly after their appearance they were caught and temporarily inundated by the advancing wave of the Great Leap Forward movement (1958-60).

The movement had as one of its chief characteristics the rapid establishment (within a year or two) of literally tens of thousands of small enterprises, many no more than workshops or sheds, under the administration of the newly formed people's communes and their sub-units (production brigades) and of the local governmental bodies directly above them. By mid-1960, according to one report, there were about 60,000 industrial units run by the counties (*hsien*), an average of about 30 such enterprises per county, and some 200,000 units run by the rural communes, not including the even smaller shops of the brigades. These industries included iron and steel, non-ferrous metals, coal mining and refining, electric power generation, agricultural tools and machinery, chemical fertilizers, construction materials, light industries of various kinds and transport and communications.

Outside China, today's judgments on the Great Leap's small-industry experiment tend to be harsh. The movement was indeed laced with flaws: local resource bases and market conditions were not adequately investigated before construction; objective technological constraints were not observed; necessary production of small tools, utensils and household articles fell away as handicraft equipment and raw materials were commandeered by the new factories to make iron and steel and other heavy industrial goods; commune enterprises used their substantial financial freedom to make high profits by gearing production to the demands of materials-short urban factories, ignoring the pressing needs of their own peasants who could not meet such competition. The resulting acute shortages of small commodities, inferior quality, great waste of materials and equipment and an unsound drain of labor away from other activities -- especially farming -- called for rapid rectification.

Despite these grave weaknesses, the small-scale industry movement of the Great Leap period had some substantial positive effects on the country's development. Many of the thriving regional industries of the 1970s had their origin in a primitive workshop established in 1958. The idea of dispersed, small-scale, locally operated and indigenously equipped industries responsive to the needs of the localities was in many areas so good, and the enthusiasm so great, that the enterprises established transcended their obstacles and became viable. Even where the shops established during the Great Leap were forced to close, however, the initial experience with industrial methods they had afforded the peasants and the lessons, both positive and negative, to which they gave rise, proved invaluable later when local industrialization was again pushed vigorously.

The general errors in planning and organization that characterized the Great Leap Forward were accompanied by three successive years of harvest failure, and by the emergence of the Sino-Soviet dispute with the withdrawal of Soviet experts from China in June

1960. These conditions, which caused a sharp downturn in industrial and agricultural production in 1959-60, necessitated a consolidation of local industries in which the majority of the new small enterprises were dismantled. During this period policy toward small-scale local industry became the focal point of vigorous political debates between those who regarded such industry as unruly, uncontrollable and a hindrance to effective central planning, and those who saw it as a means of mobilizing local resources, arousing local initiative and combatting bureaucratism. The former charged that "those people claiming reliance on their own resources actually impair the State's interests and thwart the completion of the planned projects and the smooth progress of production". Later, during the polemics of the Cultural Revolution in the late 1960s, the mass closures of small industries in the early part of the decade was blamed exclusively on the political motivations of officials who opposed local control. There is indeed evidence of political opposition to local industrialization at this time, but there were also strong economic reasons for the mass closures that took place.

Nevertheless, despite the closures, a good many of the leap-originated enterprises survived or were restored when economic conditions began to improve in 1962. The Chinese press of this period is replete with examples of localities with flourishing small and medium industries even in backward areas, such as Kansu Province in Northwest China, which had not been able to make its own nails in 1949, but which had some 70 farm equipment factories in 1963 (compared with 5 in 1957, before the Great Leap) producing chemical fertilizer, cement, water pumps, diesel engines and insecticide sprayers. In the economically advanced regions of the country, development of small industry was more extensive. While the impetus of the Great Leap years was certainly lost, the level and growth of small industrial activity in the early 1960s was undoubtedly far greater than in the years preceding the leap. Just as important, these industries were on a much firmer basis, producing goods that were locally needed at costs not unreasonably high, and without the waste that had characterized such great leap phenomena as the 'back-yard iron and steel' units.

It was from this relatively sound foundation that rural industrialization entered a dramatic take-off phase during the Cultural Revolution in the late 1960s. Under the stimulus of that movement's encouragement of local, decentralized initiative, and with the more cautious central planners under attack, various provinces and *hsien* began to report growth rates for local industries of a magnitude that had not been seen since the Great Leap. The new industries were closely linked to agriculture. For example, the production capacity of small nitrogenous fertilizer plants -- a sector that had already grown considerably during the early 1960s -- increased by 5 times between 1965 and 1969. The share of local plants in national

fertilizer output rose from 12% in 1965 to over one-third in 1969, to 43% in 1970, to 60% in 1971.

Local industrialization in the years preceding the Cultural Revolution centered on chemical fertilizer and cement production, the manufacture and repair of farm equipment and machinery, and farm products processing industries. These continued to be stressed in the spurt that began in the late 1960s, but they were joined by a rapid spread of local power industries (hydroelectricity and coal) and of local iron and steel production. The latter industries provided a producer goods base for local self-reliant development far more extensive than had previously existed. The number of small hydroelectric stations built in the two years 1970-71 was said to exceed the total for the previous 20 years; by early 1972 there were some 35,000 such installations in China providing 16% of the total national installed hydroelectric generating capacity. The rapid extension of electricity to areas previously without mechanical motive power was of great importance in "forcefully stimulating the development of local industry". For example, in the much publicized Lin *hsien* of Honan Province, the extensive development of some 244 county- and commune-run industries had to await the coming of electricity with the completion of the famous Red Flag Canal in the late 1960s.

Iron and steel had been perhaps the major victims of the closures of small plants in the early 1960s, and there was no evidence of any significant revival of this local industry until the end of the decade, when county-run blast furnaces began to go up in numbers, turning out 3 times as much pig iron in 1970 as in 1969. By 1971, all provinces, municipalities and autonomous regions except Tibet had their own small and medium iron mines and iron and steel plants, which were responsible for one-fourth of the iron ore and one-fifth of the pig iron produced in the nation. The erection of numbers of small and medium-scale oxygen top-blown converters brought a rapid increase in steel production in many provinces. The development of this industry on a local basis was significant: it released the local machine-building and other industries to some extent from the need to obtain scarce centrally produced iron and steel.

Thus, from the late 1960s on, rapid development of the "five small industries" (iron and steel, cement, chemical fertilizer, machinery, and power) provided the basis for relatively comprehensive "local industrial systems", whose components had tight backward and forward linkages with each other and collectively with agriculture. These "small but complete" systems were most often at the level of the *hsien*. Their completeness was relative; while striving for self-reliance, they sought and received aid from higher levels in obtaining a certain irreducible minimum of sophisticated equipment, technical assistance, and sometimes investment funds. Their erection

was aided by the politics of the Cultural Revolution, and by a run of consecutive good harvests that provided raw materials as well as local savings to mobilize.

The speed of local industrialization decreased after 1972, as the local networks filled out in those areas of the country most advantageously situated with respect to raw materials and markets, and perhaps as a more central-control-oriented leadership exercised authority.

Functions of Intermediate Technology

Rural industries using intermediate technologies produce only a small share of aggregate industrial production. Much of commune, brigade and team non-agricultural activity is still of a handicraft nature. The rural collectives produce most of the national collectively produced industrial output, which, according to one report, constituted 14% of total industrial output in 1973. Only at the level of the commune is a substantial portion of this production carried out by industrial (as opposed to handicraft) methods. Above that, the counties are the major locus of intermediate technologies. Thomas Rawski estimates that the "five small industries" under county jurisdiction together produced about 6% of the gross value of factory production in 1972. Adding the output of county-run farm products processing plants and commune-operated factories, an impressionistic estimate of the size of the entire rural sector using intermediate technologies would put its output at about 10% of China's factory production. While small, this is not insignificant, approximating the entire industrial output of the country in 1952.

The importance of this sector to the Chinese economy is greater than its proportion of aggregate output suggests. The principal constraint to industrial expansion in China has been the growth of farm output. The key to stimulating the latter is to equip agriculture with new, high-yield seed varieties, which in turn require increased supplies of chemicals, water and (especially in some localities) machinery. Directly responsible for accomplishing this task are those industries most characterized by intermediate technologies. The provision of increased and regularized water supplies, for instance, requires large quantities of cement for water control construction. The share of small plants in national output of cement has risen steadily to 50% or more, at the same time that national output was itself growing rapidly. The number of small plants increased from about 200 in 1965 to 2800 in 1973. Similarly, the realization of increased yields from old and especially new varieties requires heavy additions of plant nutrients, and the chemical

fertilizer industry has been one of the most rapidly growing industries in China since the early 1960s. The share of small plants in this industry grew to 60% in 1972, then dropped back to about 45% in 1974 as substantial investment in large-scale plants began to bear fruit. It appears that the bulk of all but the heaviest farm machinery and equipment is produced by local small and medium plants. We have already indicated the importance of small-scale production in the power and the iron and steel industries. So, it is the sectors with particularly close forward links with agriculture that are distinguished by a substantial reliance on intermediate technology, and this is also true of food processing.

A convenient way of getting at the more important economic characteristics of intermediate technologies in China is through an examination of the national applicability of the general arguments that have been made for such technologies. This method has the advantage of providing insights into the relevance of the general propositions -- at least to the case of China, and possibly beyond. The arguments considered here fall into six categories.

(a) Employment creation: In countries with much unemployment or underemployment and with small capacity to produce -- and limited foreign exchange to import -- capital goods, the development and use of intermediate technologies will permit the absorption of more labor than would more advanced methods, while still permitting substantial increases in productivity.

The intermediate technologies in use in China's rural industries clearly are more labor-using than the advanced technologies of the urban modern sector. In the technically flexible agricultural machinery industry, for example, complex machine tools often operate under the same roof as workers casting and assembling by hand. Food processing is similarly labor-intensive in comparison with modern urban plants; but the net impact of the development of rural food processing factories on the rural labor market has been to increase labor *supply* by releasing countless individuals (mostly women) from the arduous tasks of hand grinding and milling. In the small-scale cement and chemical fertilizer industries, the technical coefficients of the main production processes are more rigid, so that labor-intensive adjustments are largely confined to ancillary processes such as materials handling and transportation, and to the construction and enlargement of facilities.

In sum, despite the relatively labor-intensive character of the small rural industries, their direct labor-absorbing impact has been small. Sigurdson has estimated that in Hopei Province in 1973, for example, rural industries employed in permanent year-round posts only about 2.5% of the labor force, and in seasonal or temporary

industrial jobs another 2.5%, for a seasonal peak total of 5% of the labor force. In the counties visited by the American Rural Industries Delegation, from 4 to 8% of county labor forces were engaged in rural industries at their seasonal peaks. Moreover, not all of these workers are net additions to the industrial work-force, since some were originally handicraftsmen who were tapped for factory work because of their skills or when their shops were upgraded into factories.

The small direct labor-absorbing effect of rural industries is regarded in China as an accomplishment rather than a failure. The planners definitely do not strive to make these industries employment creators. Quite the contrary; and since the surge of rural industrialization in the late 1960s they have put strict limits (which probably vary by county) on the proportion of a county's labor force that may be industrially employed. They strive constantly to mechanize technologies, often in labor-saving ways. Most areas of China have traditionally experienced labor shortages in one or more peak agricultural seasons during the year. With the advent of large-scale water conservancy and farmland capital construction work in the 1950s and 1960s and the spread of high-yielding rice and other plant varieties throughout large areas of China, the peak seasons have multiplied to occupy a much larger portion of the year, and substantially more labor than before has been demanded at any given season. Rural industries, by playing a major role in equipping the communes with the cement, fertilizer, insecticides, and pumps required to adopt new and more labor-absorbing farm technologies, have thus helped to limit the farm labor surpluses available for their own expansion.

Thus, the main employment-creating effect of China's rural industries has been the indirect one of counteracting the diminishing returns to labor-intensive cultivation by providing agriculture with modern types of inputs that are complementary to labor. The success of this indirect employment-creating role has constrained the direct absorption of labor by the small industries. For the last several years, it has been clear that further growth of rural industrial output will have to come chiefly from increased productivity, at least in the near future.

(b) <u>Differences in factor markets and social costs:</u> Variations in factor price ratios can lead to the adoption of different techniques in different regions or sectors of the economy. In China, of course, factor prices are fixed by the state, and their relation to real relative scarcities is often not readily apparent. Regional or urban-rural differences in nominal relative factor costs may be as much a result as a cause of policy. There are, however, identifiable forces acting on factor prices in such a way as to enhance the attrac-

tiveness of relatively labor-intensive technologies in rural and small town areas.

Average wages for regular workers in county factories appear to be only about three-fourths as high as those in factories run by the center, the provinces and major municipalities. In the industrial enterprises operated by communes and brigades, wage levels are determined by collective rather than state policy, although subject to state guidelines. In some of these units permanent workers receive fixed monthly wages, usually lower than those in county factories, but the more common practice is to allot them workpoints as is done with agricultural workers. Their incomes are then determined by the size of the annual net income earned by their collective. The recommended practice is to set the workpoint values of commune industrial workers so as to enable them to earn somewhat but not much more than the average peasant. Temporary workers in these factories are usually paid in the latter fashion. As for temporary workers in county factories, the county may pay them part of their wage directly and send the rest to their home brigade, where it will serve to swell the workpoint value for them and their fellow brigade members.

Thus, in the collective industrial enterprises, wage levels are geared to be slightly higher than average incomes in agriculture, and they are somewhat higher in county industries. But it should be kept in mind that living costs are a good deal lower in rural areas than in large cities, and that the skill level of the workers is substantially lower in the former. How much difference in real wages per unit of equivalent labor remains after discounting for these considerations is unknown.

If one focuses on social costs per worker: to bring a rural inhabitant into one of the urban locations of modern industry would entail substantial infra-structural costs in providing housing, transport and sanitation facilities, etc. In the communes and county seats, however, workers often continue to live in their villages and require little or no such investment. The opportunity cost of their industrial employment is minimized in that they are available for agricultural labor during the heavy seasons, as they would not readily be once moved to a large city. Clearly, rural location enhances the flexibility needed in an economy still heavily dependent upon the seasonal demands of agriculture. It should be pointed out, however, that while China has acted to prevent the further expansion of the biggest cities, intermediate towns and cities are continuing to grow quite rapidly, and the social costs of expanded employment in such medium-sized urban areas are apt to be quite high.

If labor tends to cost less in rural areas, the costs of using sophisticated and expensive capital equipment are undoubtedly higher

there in the absence of developed power, maintenance, skilled labor and transportation facilities.

(c) Overcoming rural transport limitations: Despite considerable improvements in China's transportation system, much of the vast hinterland is still served only by poor roads or footpaths. Away from the railroad or a navigable waterway, transport costs escalate rapidly, particularly for items of high bulk-to-value ratio. For example, in one county a 25-mile haul by truck raised the price of coal by 50%. Under these conditions, to transport locally available raw materials to central, large-scale production facilities and then haul the products back to the localities for consumption would be extremely costly. Where transport costs are high, therefore, it will be cheaper to produce locally on a small scale, and to use technologies whose avoidance of long distance transport costs more than compensates for their relatively high production costs.

This factor is undoubtedly a major part of the reason for the attention given to small rural industries in China. It is most apparent in the cement industry. Jon Sigurdson has shown that, based on the cost of truck transportation in Hopei Province in the early 1960s, a centrally-located rotary kiln cement plant producing 288,000 tons annually for distribution to 9 surrounding county seats would have to incur production costs about 18% lower than the hypothetical alternative of each county establishing its own 32,000 ton vertical shaft kiln plant, in order to overcome transport cost disadvantages. He doubts that the difference in production cost is that great. The American Rural Industries Delegation was told that a small plant in Shansi Province was able to provide cement at 25% lower cost per ton than the delivered cost from the nearest modern plant.

Poor rural transport facilities figure in less direct ways as well. For example, much of the nitrogenous fertilizer made by China's small plants takes the form of ammonium bicarbonate. This product deteriorates rapidly and therefore must be used soon after production. Clearly, where transportation is time-consuming, it is advisable to locate plants near the points of use. Given the product and the transport constraint, local small-scale production appears quite rational.

In the agricultural machinery and equipment industry, greater responsiveness to widely varying agricultural conditions is often cited to explain the emphasis on small and dispersed local production. To some extent this is because it is felt that local people best understand their own conditions and are culturally more sensitive to the demands of their neighbors. But the argument is certainly strengthened by the physical difficulty that would be faced

by personnel in large urban factories who attempted to study at first hand the problems of customers in remote and inaccessible villages.

The rural transport constraint, then, appears to be a substantial part of the explanation for China's emphasis on rural small-scale industrialization. As the rail network expands and roads are improved, this factor will diminish in force. Consolidation, enlargement and technical improvement of the rural plants can be expected to accompany this process, as they indeed already have. But there will still remain other reasons for the continued reliance on intermediate technologies in a range of industries.

(d) Concern for savings, and farm labor demand: The possible links between the savings rate and the choice of technique may be stated as follows: technical choice influences the distribution of income, particularly as between wages and profits. If the propensities to consume out of these two forms of income differ, then the savings rate will vary according to the choice. If the existing rate of saving is regarded as too low, and political or technical considerations constrain the use of other instruments to increase it, then the choice of technique may be made contingent not only upon the size of the resulting output but also upon the amount of saving generated for future growth. [Note: A mathematical model used to show how technologies affect total saving under different assumptions is omitted here.]

It is difficult to say whether Chinese planners regard the savings rate as too low and use technical choice policy as a means of raising it. The aggregate rate of saving is quite high in China, upwards of 25% of national income. There is evidence that local planners seek to raise financing for investment in heavy industries by attracting consumers with new kinds of factory-produced consumer goods that sell at high prices, earning substantial profits for the state. These profits are necessary to subsidize losses frequently made in local production of heavy industrial goods, particularly iron and steel. It is not unlikely therefore that local planners choose techniques with an eye to minimizing losses in heavy industrial production and increasing the profitability of light industrial lines.

If this is indeed the case, then it becomes relevant to inquire into the difference in saving rates between wage earners and profit recipients. Sen points out that such a difference "is likely to be spectacularly true in a socialist economy, where the profits are earned by the state", and China is certainly a case in point. State enterprise profits account for the great bulk of state revenue, which in turn constitutes the largest contributor to aggregate savings. With respect to wages in rural industry, we have also seen

already that the real wage per unit of equivalent labor is somewhat but not much lower in county-run industries than in the modern sector proper. In commune industries wages are lower, but still designed to be above peasant incomes.

So far, the parameters examined suggest (it is hardly more than a suggestion) that China should be moving away from the most primitive, labor-intensive techniques in rural industries toward greater capitalization and technical sophistication. There still remains, however, the difference between savings rates in agriculture and industry. This gap is probably not as great as might at first be suspected, for two reasons. First, the collective organization of the commune and its sub-units probably goes some distance toward eliminating the "isolation paradox", under which individuals acting only for themselves are unwilling to save as much as they would on the assurance that everyone else saved more as well. Second, collective savings decisions are closely tied to investments, the fruits of which are easily perceived by members of the collective, providing a strong incentive to stimulate collective saving.

Despite these considerations, there undoubtedly remains a significant difference in savings rates between agriculture and industry because of the differences between these sectors in *per capita* product, personal incomes, and the relative propensities to save of state organs and collectives. There is no evidence, however, that such savings differences are a serious factor in the choice of industrial technique. On the contrary, Chinese statements on local industrial policy often caution strongly against building or enlarging rural industries in such a way as to affect agricultural output. Further, there is a limiting factor of importance, namely, the dependence of rural industries as a whole upon agricultural raw materials, which have been periodically the operative constraint to their expansion. Without adequate increase in agricultural output, the higher savings *rate* in industry becomes irrelevant since industrial production itself is stunted.

China began its extensive experiments with rural industry in 1958 using extremely primitive techniques, such as the famous "backyard iron and steel' sheds. An early cement factory resorted to hand crushing of raw materials, cost a mere ¥1000 to build, and produced nine tons per year. The considerations highlighted by the model of this section suggest some (by no means all) of the reasons why the Chinese should have been moving toward larger scale and greater technical sophistication in their rural small industries. That such movement has occurred and is continuing at present, has been noted by virtually all observers. [Comment: the move toward "modernization" has accelerated since this article was first written.]

In the local cement industry, as an example, a wide variety of different scales of production and levels of mechanization are in use today, from commune plants with small, manually operated, egg-shaped kilns that produce a few hundred tons per year, to large vertical-shaft kilns embodying fully automatic charging and discharging operations and producing up to 50,000 tons per year. Standard plant designs supplied by the government provide for kilns ranging in annual production capacity from 7000 to 44,000 tons. None of the technological variants are new or unknown outside China; aside from local adaptations, they conform to methods abandoned in the industrialized countries since the early 1920s. (Few of China's intermediate technologies are really new; rather, they are known and have been abandoned as obsolete or uneconomical elsewhere.) The rural cement industry in China today is quite capital-intensive, especially in comparison with its primitive Great Leap origins. The standard model for a small county-level plant with a capacity of 32,000 tons involves an investment cost per worker of ¥3350, some six times the annual wage of its workers. This, too, is characteristic of the general direction of Chinese rural industries currently. Thomas Rawski estimates that the capital-intensity of the core processes in China's county-level rural industries today does not differ greatly from that of large Chinese plants in the 1950s.

Finally, despite the existence of standard plant designs, the typical story of individual plants visited by foreign observers or written about in the press is one of small and primitive beginnings followed by constant expansion and modernization as technical skills develop, market demand increases, capital equipment becomes accessible or cheaper, and as labor supply tightens. This too, seems typical of other rural industries. Of course, other factors help explain the increasing capital-intensity and sophistication of China's intermediate technologies. However, the growing demand for labor in agriculture brought about by land-augmenting technical change, and the desire to capitalize on higher reinvestment rates afforded by more capital-intensive techniques are probably among the most significant causes.

(e) <u>"Walking on two legs"</u>: So far we have been concentrating almost exclusively upon the intermediate technologies of the rural industrial sector, without explicitly recognizing the existence of a modern sector with large-scale plants and highly capital-intensive technology, which produces the great bulk of China's industrial output value. We have noted rural transport constraints; but China's deliberate pursuit of a policy of technological dualism rests upon more than transport bottlenecks, important as these are. Mao-Tse Tung's "walking on two legs" directives, such as "It is better for the initiative to come from two sources than from only one", suggest a positive motivation for such a policy. In fact, China has never

considered foregoing the rapid development of a modern, large-scale 'backbone' industry, and intermediate technology has always been considered a supplement to, not a substitute for, this sector. The belief has been that some opportunities for development would be missed if the localities were not encouraged to build industry on the basis of the more primitive technology available to them.

The basic assumption behind this belief is that there exist throughout the country many kinds of resources, from the intangible but important local initiative (discussed further below) to scattered or low-grade mineral deposits, small streams for generating hydroelectricity, and waste or scrap materials from larger plants that are of no use to the modern sector. Such resources can be used to produce locally needed articles, especially inputs and equipment for agriculture, thus supplementing the output of modern industry which is constrained by shortages of high-grade fuels, raw materials, skills and foreign exchange. An essential corollary of this rationale is of course that the intermediate sector does not further constrain modern industry by competing with it for factors of production.

This rationale for intermediate technologies, which is quite independent of the other explanations discussed so far, is explicitly emphasized in virtually all Chinese policy statements on the subject. It also has two observable implications that we may look for in the behavior of small industry in China. First, as industries utilizing intermediate technologies reach a scale at which they exhaust their specific and non-competitive resource base, they must either 1.) cease to expand, or 2.) be taken over by the modern sector, leaving their previous function to more primitive newcomers. This appears to have happened on a wide scale in the early 1970s as a result of the rapid growth of rural industries stemming from the Cultural Revolution years. It can also be observed in individual enterprises, as they outgrow their local resource base or market.

For example, Tsunhua county's iron and steel plant became subject to provincial control when, as a result of expansion, it began to receive investment in the form of steel rolling equipment and large-scale electrical machinery from the province in 1972. At this point, both its investment and its output became part of the state plan at the provincial level, the allocation of both becoming a provincial responsibility. In the case of the Hui county Cement Plant of Honan Province, a plant that was built in 1964 with only one egg-shaped kiln producing 4 tons per day, had by 1975 added 9 additional kilns, including one automatic vertical shaft kiln, and was producing 400 tons per day. But this plant had recently had a substantial labor force reduction, and its 6 egg-shaped kilns were standing idle. Moreover, it had given up its original name, Peichuan, because the local commune of that name had established its own cement works (as had five

other communes in the *hsien*). This enterprise may have been reaching the end of its ability to expand within a purely local context.

The other implication of the 'walking on two legs' model is that, as the constraints limiting expansion of the modern sector are removed, some of the needs previously met by the intermediate sector become subject to more efficient fulfillment by modern industry. It is probably premature to look for widespread evidence of such a phasing out of local intermediate technologies in China so soon after a period of their rapid expansion, but one clear example of it can be seen in the chemical fertilizer industry. Here, as we have seen, the proportion of total output produced by small plants dropped from 60% in 1972 to about 45% in 1974 as a result of substantial growth in large-scale productive facilities benefiting from economies of scale, and producing a fertilizer with high nitrogen content and less problem of deterioration. In 1971-74, China contracted to purchase 26 chamical fertilizer plants from abroad, including 13 very large urea plants from Western European, Japanese and U.S. firms. As more of these plants have entered production, it is likely that the small-scale sector has undergone further relative decline.

China's nitrogenous fertilizer industry contains one of the few Chinese examples of a new intermediate technology, and the 'walking on two legs' reasoning explains its use quite well. Ammonium bicarbonate is a principal product of the rural fertilizer plants, although it is used nowhere else in the world as a fertilizer. Its advantage lies in its constituting a relatively inexpensive and simple method of taking advantage of small, local supplies of coal, lignite, methane or other sources of hydrogen, to produce a usable solid fertilizer. Its disadvantages are a relatively low nitrogen content (17.5% as compared with urea's 46% nitrogen), and a tendency to lose amonia rapidly during storage and transportation. Hence its large-scale production in centralized locations far from ultimate use is out of the question. But its value when produced in small quantities with local materials for prompt use on adjoining fields is substantial.

Thus, the technological dualism of 'walking on two legs' would seem to have some solid economic advantages at this stage of China's development. Of course it is pursued for additional reasons as well, and these are best taken up in the context of our final category for analyzing China's intermediate technologies, the quest for self-reliance.

(f) <u>Self-reliance:</u> The literal meaning of the Chinese term for self-reliance, "regeneration through one's own effort", conveys a more accurate meaning than that of autarky frequently associated with this term. Self-reliance is related to 'walking on two legs' in that it constitutes the framework of motivation, political work style, and

inter-unit economic relations that should promote the exercise of initiative by each leg. The most obvious economic objective of self-reliance at the local level is the development of local industrial production on the basis of those resources locally available. But the notion of self-reliant development has other aspects to it besides immediate output growth.

First, it is designed to stimulate initiative by placing the political responsibility for undertaking development planning with the individual counties and communes themselves. It frowns upon the passive stance of waiting for the central authorities to arrive with aid. At the same time positive incentives are provided in the minimization of bureaucratic hindrances to local efforts, and in permitting the units involved to retain the bulk of their profits as long as operations remain strictly local. With this kind of encouragement, it is clearly in the interest of local populations to support rural industrialization programs. The kinds of technologies involved are installed quickly and begin paying off in dramatic and easily perceived ways: telephone poles erected, electric lights becoming available, more fertilizer for the fields, labor-saving machinery, canned and bottled fruits and vegetables for the table, and money from the higher incomes to pay for cooperative health insurance and better commune schools. There is little doubt that the rural industrialization of the past decade originated in local enthusiasm; however, much of it was stimulated by centrally sponsored ideological campaigns and Tachai-type models.

If the center's primary role is the educational one of demonstrating how self-reliant development can be undertaken, it also plays an important supportive role financially and technologically. The national government's fiscal relationship with the provinces has been shown to be a highly redistributive one. The most developed provinces (and province-level municipalities) such as Shanghai, Liaoning and Kaingsu remit to the central government 70-90% of their provincial revenues, while the poorer provinces keep their entire revenues and receive central subsidies as well. It would seem that some such redistribution occurs at the intra-provincial level also. Thus, those poor localities most disadvantaged in building industry can get assistance from their provincial or regional government that would not be available to others.

That such assistance takes place does not contradict the principle of self-reliance. Like matching grants elsewhere, it can be a spur to greater local efforts. A county, knowing that it will qualify for aid from its province if it can reduce the need for external assistance to a few pieces of key equipment beyond its own production capacity, will have a greater incentive both to initiate the effort and to limit its demands on the higher level. Thus, in most small plants, although the proportion of self-provided equipment is high,

there is some element of machinery supplied by a technologically superior level, or even imported. This is perhaps most systematically noticeable in the rural chemical fertilizer industry, much of whose equipment has been provided by Shanghai factories.

Technical assistance is also provided by the center. The basic designs for small industries originate with central research institutes, whose technicians frequently travel to the rural areas to study their problems and give assistance. Modern factories provide advice as well as discarded equipment to their rural counterparts. The center also plays a role in allocating skilled labor emerging from the universities and technical institutes. Without these kinds of intervention by higher levels, self-reliance would have strong centrifugal ramifications, with localities in the most favored regions and those boasting a higher original industrial base growing away from the less fortunate areas. It is probable that this has occurred, despite the state's redistributive role, in absolute terms -- i.e., that the absolute growth in local industrial production of richer regions has exceeded that of poorer regions, even if *relative* growth rates have been higher in the latter.

Self-reliance of course also speaks to other objectives in the official 'social welfare function' besides the purely economic ones discussed above. For example, the goal of preventing excessive urbanization is a complex one, requiring not only administrative controls on migration but also the creation of a dynamic momentum in rural areas, involving new employment opportunities, changes in cultural facilities, changes to use newly acquired skills by young people emerging from high schools, etc. The development of rural industry is an essential link in this chain. Similarly, the organic link between rural industry and surrounding agricultural activities is partly designed to counter the "contradiction between industry and agriculture" and "consolidate the worker-peasant alliance". Thus, commune industrial workers, whose incomes are close to those of their peasant neighbors with whom they continue to live and even work during the heavy season, will be less likely to develop a sense of superiority and privilege that makes them insensitive to the concrete needs of the farm population and to the low general income level of the country. Local self-reliant industrialization is also regarded as a safeguard against the excessive concentration of bureaucratic power at the center, and was explicitly defended in those terms during the Cultural Revolution. The more even spread of economic power throughout the country has inevitable consequences for the distribution of political power as well.

Finally, self-reliance involves dynamic externalities that are important to any developing country or region. The generation of knowledge, experience and skill that accompanies the local produc-

tion of a machine is obviously far greater than the similar characteristics attached to one imported from abroad or purchased from a distant city. In this respect, the agricultural machinery industry in particular has been responsible for the training of thousands of workers and the education of their neighbors with regard to industrial techniques.

Conclusion

In working through the various perspectives for understanding the objectives of China's rural intermediate technologies, we have proceeded from some very specific goals, such as job creation and the circumvention of transport constraints, to some very broad ones, such as narrowing the urban-rural gap and resisting bureaucratization. Ultimately, even the most general objectives reverberate in the sphere of production, and it is extremely doubtful that China would pursue a set of socio-political goals which had severe negative implications for economic growth. Nevertheless, the range and complexity of relevant considerations, as well as of the technologies adopted themselves, makes any summary judgment of the optimality of China's approach difficult.

After two decades of honing and adjustment, however, the intermediate technologies of China's rural areas do seem to be accomplishing their various objectives, judging by published accounts and the growing volume of travellers' reports. It is difficult to conceive of an alternative strategy that would not sacrifice some of these goals in the service of others. In fact, given the constraint posed by the development of agriculture, and the problems encountered in the 1950s with overcentralization of control over industry, it seems unlikely that a policy of putting even more emphasis on the modern large-scale industrial 'leg' would lead to faster growth of national product, or even of total industrial output. Therefore, on the basis of the evidence available, it is reasonable to conclude that China's rural intermediate industrial technologies are appropriate to the conditions in which they exist as well as to the tasks they are intended to accomplish at the current stage of development.

[Extracted from World Development, Vol. 6, No. 11/12, November/December 1978, pp. 1297-1309.

Case Studies of Technology Sharing By U.S. Firms in Algeria and Brazil

Jack Baranson

[Recent economic trends have induced some U.S. companies to more actively transfer to other countries relatively sophisticated technologies and the ability to use them. Technology buyers are gaining in bargaining power. Two cases of technology transfer contracts of U.S. firms, with Algeria and Brazil, are examined, indicating advantages seen by both sides.]

Certain trends in the world economy have compelled a number of U.S. corporations to alter their mode of foreign involvement and to revise policies governing the management of their technological assets. In these changing circumstances, U.S. firms are finding new opportunities to earn returns on their managerial and technological assets. In some instances, the "product" they sell has become the implanting of design and engineering capabilities in foreign countries. Technology purchasers face new sets of options and opportunities for acquiring foreign know-how, usually on more favorable terms.

Changes in corporate perspectives. From the corporate perspective, the attractions of equity investment in and managerial control of foreign facilities are decreasing. A growing number of U.S. firms have decided that the risks associated with overseas capital investments have become too high for the realized rates of return. Aside from political uncertainties in a widening area of the world, there are economic vicissitudes brought on by world inflation, exchange rate revaluations, and recessionary cycles, all of which have added to the risks of locking into fixed

Mr. Baranson is President of Developing World Industry and Technology, Inc. (DEWIT) a research and consulting firm, Washington, D.C.

investments in a world of changing circumstances. These uncertainties have been compounded by the fragmentation of world markets resulting from import substitution behind tariff barriers and regional trading blocs. U.S. firms are investing abroad with greater caution: net capital outflows, for example, declined 27 percent in 1976 to $4.6 billion.

The growth of host country restrictions, regulations, and limitations on foreign investment has also tended to detract from this traditional mode of overseas involvement. Import restrictions are commonly imposed by countries that, like Brazil, suffer balance-of payments deficits due to increasing oil import bills. Even some of the oil-rich countries, such as Venezuela, keep a close eye on imports and costly foreign-exchange expenditures. Another inhibiting factor in this area is the limitation by law of employee layoffs. In some countries these laws are so strict that a U.S. corporation is forced to consider labor a fixed cost, regardless of prices or demand for the product. In addition to being legally obligated to make individual termination payments, some U.S. corporations must also develop, in collective bargaining with unions (and sometimes with the government), "social plans" which require additional cash indemnities to workers.

At the same time that certain changing circumstances in host environments have soured corporate attitudes toward direct investments in overseas plants, there is evidence that some U.S. firms are encountering difficulties in adjusting to technical change at home and in obtaining competitive production in the high-wage U.S. economy. Production in other countries of labor-intensive components of manufacturing for reexport back to the U.S. for final assembly has long been a practice of U.S. industry. Today, some of the more capital-intensive elements (such as entire engine plant facilities) are also allocated to foreign affiliates in order to maintain competitiveness in world markets. Certain firms are also retrenching from new investment commitments in basic research aimed at new product development in favor of more pragmatic, quick-payoff development of existing technology. Explanations for the reorientation in R and D by U.S. corporations include continued high rates of inflation, shortage of capital funds due to the stock market slump, fierce competition worldwide in high-technology industries, and uncertainty about U.S. government regulations and policies.

An increasingly interesting alternative to either overseas or domestic investment in production facilities and R and D has emerged in the sale of manufacturing know-how and related services, such as training of foreign nationals in technical and managerial aspects of operating industrial systems, or assistance in procurement, start-up, and international marketing.

<u>Enhanced bargaining leverage of technology purchasers</u>. The degree of autonomy U.S. corporations have traditionally enjoyed in

making decisions as to the kinds of technology they released and the terms of transfer has been considerably diminished by a gradual increase in the bargaining leverage of technology purchasers. The enhanced bargaining leverage derives from a variety of new conditions which redound to the advantage of non-U.S. purchasers. Any one condition, in and of itself, is not necessarily determining; but combined, these new conditions result in a marked shift in the balance of bargaining leverage between technology suppliers and purchasers in favor of the latter.

This shift in bargaining leverage is perhaps most immediately attributable to the proliferation of alternative sources of similar, if not equally attractive, technology sought by a purchaser. The number of product and process fields in which the U.S. industry holds a monopoly position in know-how is rapidly declining. That enterprises in other industrially advanced countries have become alternative suppliers of first-class, operative technology is a result, in part, of an earlier proliferation of design and manufacturing capabilities by U.S. firms. The Japanese, for example, have become significant competitors with U.S. technology in the late 1950s and 1960s. The socialist countries might follow suit in time, depending on the volume of transfers and the efficiency of implantation.

Developing nations with oil and mineral resources have begun to use their newly derived wealth to acquire industrial facilities and know-how to process their raw materials for world markets. Most of these resource-rich countries have heretofore played marginal roles in the world economy. Their greatly enhanced earnings obtained from coordinated pricing and volume-of-production policies have given them considerable bargaining leverage in negotiating with multinational corporations. This kind of leverage has accrued not only for the oil-rich countries but also to a lesser extent for nations having bauxite, copper, and other raw materials. The ability to pay in hard currency for expensive technology, which eliminates complicated and long term financing arrangements, is being used as strong leverage in negotiations.

A final factor in the shift in bargaining leverage has been the perceptible upgrading in recent years of the knowledge and skills which technology purchasers bring to bear in negotiation sessions with multinational corporations. Trained in the best business and law schools in the world, negotiators for purchasing enterprises have become well versed in the laws concerning industrial property rights, patents, trademarks, and industrial know-how.

[The original study goes on to present 16 case studies of advanced technology sales in the aircraft, automotive, computer, consumer electronics, and chemical engineering industries. Two of these involving developing countries are summarized here.]

Case Study 1: GTEI's Turnkey Plant in Algeria for the Manufacture of Consumer Electronics Products

Late in 1974, GTE International, Inc. (GTEI), a subsidiary of the General Telephone and Electronics Corporation (USA), signed a contract for the construction of a $232 million consumer electronics manufacturing plant with the Algerian enterprise SONELEC. SONELEC is the state corporation responsible for the development of an Algerian consumer electronics industry. The *produits en main* contract requires GTEI to develop a vertically integrated operation that is virtually self-sufficient in component parts manufacturing including semiconductors, final product assembly, and product design-engineering. (*Produits en main* contracts are similar to "turnkey" projects: the supplier provides training of all levels through top management, all the equipment, and aims to provide the purchaser with self-sustaining ability to operate with no outside help.)

The transaction is significant because of its size and its potential impact on the world consumer electronics industry. It is also illustrative of the scope of development goals Algeria has set for itself. Basically, SONELEC has purchased the capacity to become a significant factor in international consumer electronics: when the vertically integrated plant comes on-stream, SONELEC will have a significant export potential. It will have an independent technological base that will be supplemented by related know-how during the life of the contract, and allow the company to remain a state-of-the-art competitor. In addition, several hundred SONELEC employees are being trained in relevant technical areas so that the company will have a work force that can operate independently in the design and manufacturing areas. Finally, SONELEC will have a vertically integrated plant that will operate with limited dependence on foreign components, and will also provide existing Algerian companies in the same sector with a domestic source of previously imported component parts.

The GTEI plant is being built in Sidi-Bel Abbes and will employ 5400 people. Once completed, it is expected to have the following annual production capacity on a one-shift basis:

TV sets (black and white)	190,000
TV sets (color)	50,000
Radios (transistor)	410,000
Stereo/phono	50,000
Cassette players	60,000
UHF/VHF tuners	250,000
TV picture tubes (black and white)	238,000

The Sidi-Bel Abbes facility will be Algeria's second major consumer-electronics manufacturing facility. A privately owned facility

located at Blida has a production capacity of 200,000 TVs and 100,000 radios annually. The plant employs 1500, and it is heavily dependent on foreign components. Over 50 percent of the sophisticated parts at present are imported. It has been speculated that production at the Blida facility will wind down as the SONELEC operation comes on-stream.

At the end of 1971, there were 160,000 TVs and 700,000 radios in use in Algeria according to one estimate. By 1974, it is believed that annual internal demand had reached 120,000 new TV units and 100,000 new radios per year. Thus, Algeria could meet its current needs in radios and have a slight shortfall in TVs. The new GTEI facility will be used to supplement the domestic shortfall in TVs and in consumer areas not previously served by the domestic industry, most notably tape and cassette recorders. In addition, it will supply most of the essential component parts for the factory and the other domestic plant near Blida. Much of the surplus production in finished products is probably intended for foreign markets.

Approximately $25 million of the contract price is earmarked for technical and managerial training in the U.S. Two hundred and sixty-five SONELEC employees will receive up to eighteen months classroom and on-the-job training in the U.S. and Europe. An additional 105 Algerian students will learn English and receive instructions in relevant technical undergraduate course work. SONELEC expects that this investment will provide the complementary manpower pool of executives and technical people it needs to maximize its gains from the capital investment in this new electronics facility. Training for this industry's specific application, instead of a generic educational program, has been dictated by necessity and represents a departure from recent procedure in Algeria. There has been a flaw in Algeria's state planning: it has limited its reliance on foreign technical and executive expertise at a time of expansion when it has had an inadequate domestic manpower pool. Consequently there have been operational difficulties, quality-control problems, and market development failures in different fields. At present, its industries are operating at 30 to 60 percent of capacity.

From GTEI's point of view, the SONELEC contract offered a host of advantages and entailed acceptable levels of commercial and economic risk. First, the terms of the contract call for the transfer of technologies limited to the design and engineering of a specific manufacturing facility, and production of specific products. The contract is executed over a finite period and tied to an existing state-of-the-art technology. Although the agreement requires GTEI to keep SONELEC informed about new technical developments, they will not necessarily be incorporated into the plant. Currently GTEI is making rapid advances in technologies relevant to the consumer electronics field, and is incorporating these into its product lines;

therefore, it will probably not suffer an erosion of its competitive position in world markets as a result of SONELEC production. In any case, the TV design provided by GTEI to SONELEC is not in compliance with U.S. standards. This safeguard eliminates the possibility of exports to the U.S. market without major product-design alterations.

For several years after the plant is on-strem, SONELEC will, under the terms of the contract, continue to be dependent on GTEI for some of the key ingredients needed in the component manufacturing and final assembly. Algeria is not a traditional export market for the U.S. electronics industry, and without this contract GTEI would have virtually no export potential in this market. GTEI was interested in winning this contract because it would serve as a sorely needed stimulant for its electronics division. The company, along with the rest of the U.S. industry, was faced with the prospect of idling installed capacity because of a dramatic drop in consumer demand and the increased competition from cheaper Japanese imports during the early 1970s. The contract assured continued plant utilization and retention of trained production workers for the company's operation in New England, and would provide business for numerous local subcontractors.

In short, there clearly were substantial benefits to be derived from the SONELEC contract. And had GTEI not consumated the agreement, there were several foreign competitors who would have, including Thorn, Ltd. (United Kingdom), Nippon Electric (Japan), and IT and T Standard Electric (Germany). By not entering into the agreement, GTEI and other U.S. firms would have lost follow-on business for the supply of GTEI component parts and contingent goods and services valued in eight figures per year over and above the basic contract. The company would also have forfeited future market opportunities in this sector of the Algerian economy: once the plant is in operation, the Algerian government will close the border to competing imports. And the probability that SONELEC will become a direct competitor in world markets anytime in the near future is slim. The Algerians feel the consumer product designs they are getting from GTEI will be good enough for the Algerian market from a functional standpoint for some time to come. If at some time in the future SONELEC found it worthwhile to export to markets where GTEI is active, technological upgrading would become indispensable.

Case Study 2: The Piper Aircraft Corporation Licensing Agreement with Empresa Brasileira de Aeronautica, S.A.

In 1974, Brazil represented the largest single export market, outranking both Canada and Germany, for U.S. small aircraft manufacturers: they delivered 726 planes to Brazil in that year at a cost of $600 million. Severely pressed by this time with foreign-

exchange constraints and confident of its technical capabilities and sufficient internal market demand, Brazilian authorities felt it was an appropriate moment for the state-owned aircraft enterprise, Embraer (Empresa Brasileira de Aeronautica, S.A.) to begin a manufacturing program of light aircraft, single- or twin-engine, in close cooperation with a foreign aircraft manufacturer. Embraer was created in the late 1960s for the purpose of promoting the development of the local aircraft industry. After six years of operation, it had three lines of aircraft in production: a single-engine crop duster designed by Embraer, and two military planes under foreign license. As of late 1974, Embraer employed 3500 people and had a total capitalization of about $20 million.

In 1974, Brazil sent a mission to the major U.S. small aircraft producers to solicit proposals on an agreement for production by Embraer in Brazil of U.S. planes. Embraer approached Piper, Beech, and Cessna, the last of which held more than 60 percent of the Brazilian market in 1974. According to Embraer, all three firms were fully apprised of the rules of the game; that is, the Brazilians made explicit their intent to develop their own technical, managerial, manufacturing, and marketing capabilities in small aircraft production and to reserve exclusively the domestic market thereafter for Brazilian-produced aircraft. The second goal, it was explained, was not so much an intent to create a protected industry but an effort to realize foreign-exchange savings. Implicit in these rules was the eventual outcome that only the foreign firm prepared to enter into an agreement with Embraer would be permitted continued participation in the large Brazilian market.

In the early phases of the negotiations, competition among the three U.S. firms was spirited, especially between Cessna and Piper. Initially, Embraer had a marginal preference for Cessna because it enjoyed wide recognition and confidence within the country and an effective distributorship system. Beech dropped out as a serious contender quite early, taking the position that if Brazil wanted its aircraft, it would have to import them from its U.S. facilities. From all appearances, Cessna initially entered negotiations in earnest with a preparedness to release technology and managerial control to Embraer for production of its aircraft. Its ultimate position, however, was not unlike Beech's. Evidence of Cessna's true intent was its adamant refusal to grant Embraer authority to make modifications it deemed appropriate in the Cessna aircraft models the company chose to manufacture. A second difference that arose in negotiations concerned royalty payments. Embraer wanted no royalty obligation for manufacturing know-how acquired from the foreign partner, and Cessna felt it was a legitimate term for the agreement.

Undoubtedly, several more subtle difference arose between Cessna and Embraer during the negotiations; the outcome was that Piper was selected. As was implied by Embraer officials prior to entering into negotiations, U.S. exports of small aircraft to Brazil have plummeted. Cessna, which in 1973 sold more than 400 aircraft in the Brazilian market, sold only 5 in 1976. This sales plunge is the result of a 50 percent tax (raised from 7 percent) imposed in 1975 on imported planes of this category, and the requirement of the Brazilian government that importers make a one-year interest-free deposit covering the full price of manufactured goods bought abroad. In addition, Brazil's law of similars stipulates that once an item is produced in "sufficient quality and quantity" in Brazil and registered with the government as a product similar to its imported counterpart, it will be protected from imports.

The industrial cooperation program with Piper is based on two agreements -- one for single-engine aircraft and one for twin-engine airplanes. Under the terms of the agreements, Embraer may select any Piper model it desires for local production. Thus far, the following models have been chosen: three models of Cherokee aircraft and the Lance, Seneca, and Chieftain. Piper is responsible for providing the necessary assembly and parts manufacturing know-how and assisting in such areas as quality control, materials handling, and manufacturing. Piper has an option to use its international distribution system for aircraft that may be exported from Brazil. The U.S. firm's compensation is primarily a percentage return on the components it ships to Embraer. As the licensee progressively substitutes local content for these imports, the returns will diminish. Even at 100 percent production in Brazil, however, Piper still will be paid a fee for service in support of those aircraft. With the exception of those items that cannot be economically produced in Brazil, local substitution is expected to proceed smoothly.

At the present time, the Piper program is basically a licensing agreement; but in the medium and long term it could provide for the cooperative development of new aircraft. The agreement specifically permits Embraer to fabricate Piper aircraft for sale in the domestic market and, on occasion, to produce jointly with the U.S. company for foreign market sales; to replace on a gradual scale Piper-supplied components with Embraer-fabricated products; to initiate joint programs to share development and production of a new aircraft aimed at domestic or foreign markets; and to market one another's products through individual distribution networks. Production capability for the Piper models is being transferred to Embraer in three phases. By Phase III, Piper will be shipping all component parts for assembly by Embraer, and in three subphases will: (1) begin replacement of Piper-supplied parts by Brazilian-made equivalents, including interiors and 50 percent of both fiberglass and acrylics; (2) complete

replacement of all remaining fiberglass and acrylics and produce all harnesses; and (3) produce the aircraft completely with Brazilian-manufactured parts and components with the exception of those that cannot be economically produced in Brazil. Upon completion of Phase III-3, Embraer projects that from 66 percent to 70 percent of the Piper product will be of Brazilian origin (based on U.S. prices).

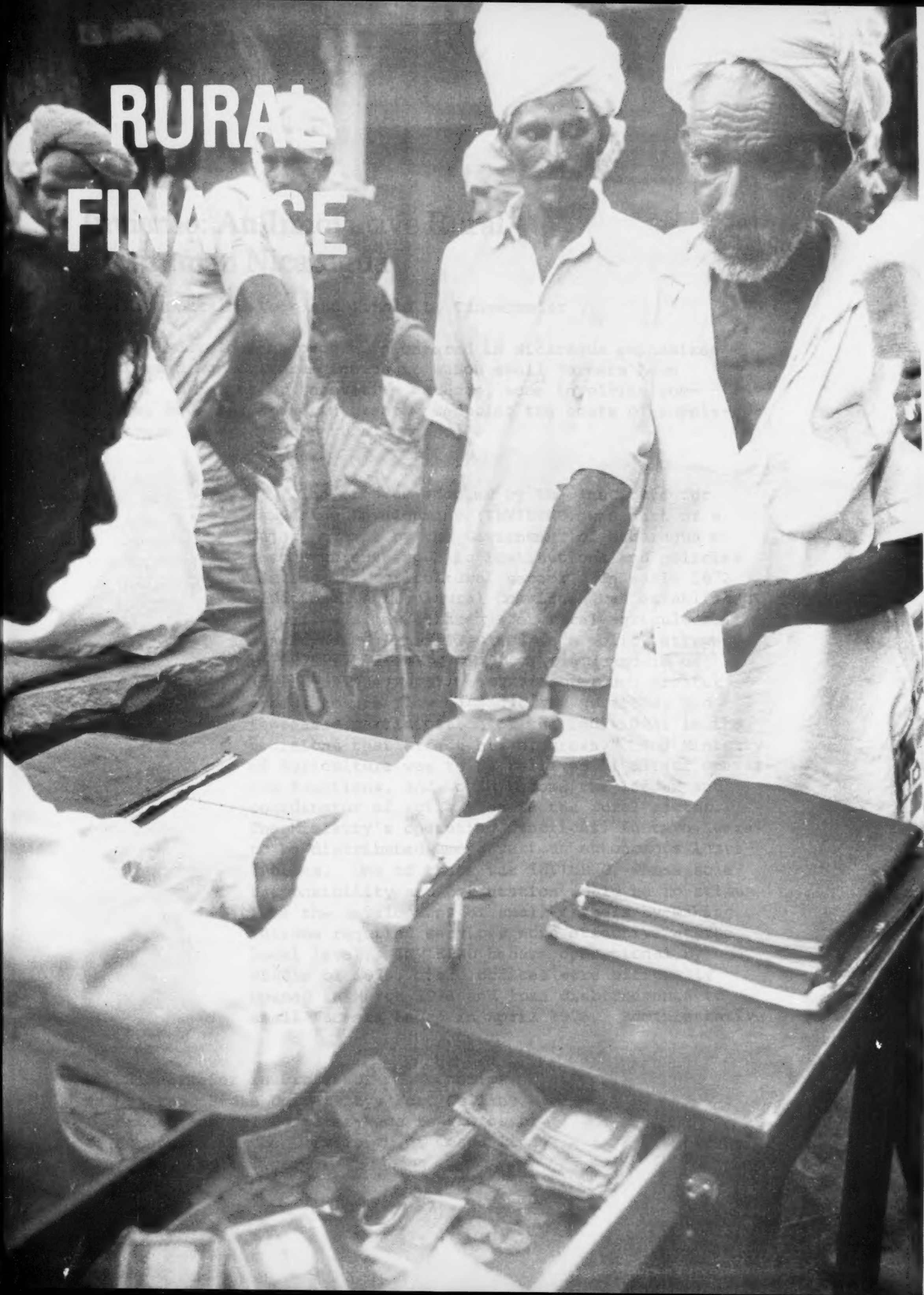
The development of the Brazilian aircraft industry has been shaped by three ten-year plans spanning the period from 1950 to 1980. A government-funded organization known as Centro Technio Aerospacial (CTA) has been given responsibility for directing this program. In the first ten-year period, CTA sought to establish a teaching and training program to develop a support structure for the aviation industry. The second period required the establishment of technically strong local manufacturers. The third period was characterized as one of increasing the sophistication of locally produced power plants, avoinics, and aircraft systems that will go into Embraer products. CTA has aided Embraer by helping it to modify its Bandeirante designs. The primary means employed to develop these supporting industries is a series of partnerships with foreign firms. An effort is made first to make each industry financially capable and then to upgrade its technical competence to aeronautical standards. To assist and accelerate the latter process, one foreign firm is normally selected for each industry. Brazil's specific areas of interest concerning foreign partnerships for developing its aeronautics industry include both reciprocating and turbine engines, avionics, hydraulics, instrumentation, and raw materials such as aluminum and steel. CTA has begun earnest discussions with a number of foreign firms in these fields.

Although the future of Brazil's aerospace industry looks promising, there are certain weaknesses that only experience and competition will overcome. Embraer is highly engineering-intensive and therefore will experience difficulty in keeping costs down. Regardless of how well engineered an aircraft is, unless it is price competitive in the international market, it will not be a successful seller. Price is especially important if Embraer expects to sell 50 percent of its EMB-12X line in the export market against such fierce competition as the Beech 100/200 and the Swearingen Merlin. Retail base prices of Embraer's Piper models average 27 percent above those charged by Piper in the U.S. Embraer-produced aircraft also suffer from low-quality interiors; the materials now being utilized will not hold up under hard use. Piper officials have indicated that they will do the completions in the U.S. should they choose to market the new pressurized aircraft through its domestic and worldwide distribution system. Another deficiency in Embraer is its lack of effective marketing tactics. Its program has been criticized by Brazilian dealers experienced in high-pressure international markets for being insufficiently aggressive.

While the rest of the South American market for light aircraft appears to be sewed up by assembly programs of Cessna and Piper in Argentina and in Colombia for the Andean Pact countries of Venezuela, Ecuador, Peru, Bolivia, and Chile, the African market is still quite accessible. Brazilian marketing efforts can be expected to aim first in that direction. If the Brazilians have aspirations of marketing their EMB-12X models in the U.S. market, they must first drop some of their own high trade barriers. The 123 and 120 could not possibly compete with Beech and Swearingen on an equal footing with a similar 50 percent import tax imposed on the airframes coming into the country.

Brazil is not unique among the more industrialized of the developing countries in its desire to develop an indigenous aircraft industry, but it may be unique in its professional approach to achieving that end. Its strategy of effectively closing entry to its markets for all but the foreign firm prepared to share front-end technology, to impart sophisticated design and engineering capabilities, and to instruct Brazilian nationals in managerial skills has been extremely successful. Foreign firms, facing narrowing opportunities to earn returns in foreign markets, have been extremely eager to meet these conditions. Brazil, a state capitalist economy, has the means to accumulate large sums of capital and therefore can exercise considerable leverage in negotiating with foreign firms. In time, the sustained enterprise-to-enterprise relationship that characterizes Brazil's effort to develop its aerospace industry will result in the implantation of internationally competitive design, engineering, and production capabilities. While the U.S. firms that have taken advantage of the opportunities offered by Brazil will benefit, other U.S. firms in the industry can expect increased competition in third-country markets from Brazilian aircraft in the future.

RURAL FINANCE



Dairy farmers in Rajasthan, India, receive payments from their cooperative. (Photo: World Bank, by Ray Witlin).

Invierno: An Innovative Rural Program in Nicaragua

Claudio Gonzalez-Vega and Ronald L. Tinnermeier

[A rural development program pioneered in Nicaragua emphasizes credit and agricultural inputs to which small farmers have access. A number of innovative methods, some involving computers, have succeeded in greatly reducing the costs of supplying these items to poor rural areas.]

The program adopted by the Institute for Campesino Development (INVIERNO) was part of a major attempt by the Government of Nicaragua to restructure the public institutions and policies serving the agricultural sector. In early 1972 a National Agricultural Committee was established to define a new strategy for rural-agricultural development. This resulted in a policy stragegy in 1975 intended to "improve the standard of living of the rural population through greater access to the flow of goods and services, and increased participation of the individual in the decisions that affect his progress." The Ministry of Agriculture was to be relieved of direct operating functions, and would become the leader and coordinator of activities in the rural sector. The Ministry's operating functions, in turn, were to be distributed among various autonomous institutions. One of these was INVIERNO, whose sole responsibility and orientation would be to stimulate the development of small farmers by making various required services more effective at the local level. INVIERNO became operational by the middle of 1975; field offices were officially opened in March 1976 and loan disbursements to small farmers began in April 1976. Administrative

Dr. Tinnermeier is Professor of Economics at Colorado State University, Fort Collins, Colorado, and Dr. Gonzalez-Vega is Professor of Economics in the University of Costa Rica, San Jose, Costa Rica.

manuals governing the organization and its procedures as well as manuals for the credit, input delivery and marketing programs were prepared during the first six month period.

INVIERNO Objectives

INVIERNO's primary objective "is to develop in the individual lower income rural farmer -- the campesino -- the capability and means which will enable him to have access, directly and jointly, or in coordination with other agencies, to the opportunities and services which he needs for his development with the purpose of promoting a sustained increase in his standard of living". The institution deals with the non-farming but rural poor as well, through development efforts of the newly formed community councils and through INVIERNO's small scale rural industry program.

To determine an individual's eligibility for the program, an upper income limit was at first set at the average national per capita income of US $590; this was converted into a farm size limit of 69 hectares. However, INVIERNO was criticized for setting such a high limit, with about 78 percent of the rural families owning less than 3.5 hectares of land or no land at all; it was thought that over time the benefits of the program would tend to accrue to those at the upper end of the scale if the maximum size were not lowered. In practice, however, INVIERNO started by serving farmers and landless laborers with sizes of farms and incomes well below these limits. One of the reasons for this has been the focusing of its efforts on farm communities with no more than 300 families, which usually are characterized by small farms. Regional concentration was also a factor: work was begun in two regions (of eight in the country) because of a large number of small and relatively poor farmers and communities in these areas. It is expected that INVIERNO will expand into the other regions when resources and financing permit, by which time costs should be reduced and lessons from experience incorporated.

The distribution of loans by size and region through September 1977 is shown in Table 1. More than 78 percent of the loans are for less than US $429 for the two regions serviced by INVIERNO. Very few loans are over $2,100, and these must go through a special review process by a senior level credit committee. The number of relatively large loans declined significantly during the second year of operation. The average size of loan also has declined slightly over time.

Table 1

Distribution of Loans by Size and Region Through September 1977

Loan Amount (US $)	Region II Number	Region II %	Region V Number	Region V %	Total Number	Total %
Less than 143	175	18.2	2,538	36.2	2,713	43.0
144 - 428	546	56.8	3,015	43.0	3,561	44.7
429 - 714	160	16.6	783	11.2	943	11.8
715 - 1000	48	5.0	286	4.1	334	4.2
1001 - 1428	20	2.0	182	2.6	202	2.6
1429 and over	13	1.4	202	2.9	215	2.7
TOTAL	962	100.0	7,006	100.0	7,968	100.0

Source: INVIERNO, ... Evaluacion.

The average size of the land area financed per loan by INVIERNO also has been very small, ranging from 1.9 to 3.3 hectares for each cropping season. As with loan size, the average size of farm of the borrowers decreased in the second year -- see Table 2. During 1976 almost half of all loans authorized were for farmers with less than 3.5 hectares of land; in 1977 this proportion increased to over 81 percent. For farmers with more than 7 hectares, the proportion of loans authorized declined from more than 30 percent to just over 7 percent. This substantial reduction in farm size resulted partly from the institution's efforts to eliminate a few large borrowers as it gained confidence in its objectives and procedures; the incorporation of Region II during 1977 also added a larger number of smaller farmers. Finally, drought problems in some areas resulted in farmers planting less, which reduced loan size and area financed per farmer.

Table 2

Percentages of Loans Authorized by Farm Size and Cropping Period

Farm Size in Hectares	1st Crop 1976	2nd Crop 1976	1st Crop 1977	2nd Crop 1977
Less than 3.5	45.0	49.0	83.2	81.1
3.5 - 6.9	22.0	22.0	10.3	11.4
7.0 - 13.9	15.0	14.0	4.8	5.4
14.0 or more	18.0	15.0	1.7	2.1
TOTAL	100.0	100.0	100.0	100.0

Source: INVIERNO: Informe...1975-1976, and Informe...1977.

Corn and beans are the major crops financed under the program. Test plots have been established to allow the financing of other crops, especially vegetables, as technical recommendations are perfected. In addition, credit was made available to rural but non-farm residents in 1977 as part of INVIERNO's comprehensive approach to rural development. In that year a total of 292 loans for $369,557, or an average of $1,265 per loan, were made to small businesses, small scale industries, service firms, and artisan works.

Innovative Approaches

Integrated services. The primary objective of INVIERNO is to improve the level of living of the low-income rural resident. INVIERNO is attempting to provide its beneficiaries with a set of integrated services. These activities include institution building, agricultural credit, technical assistance, marketing help, community action (called MOC -- to Motivate, Organize, and Capacitate), municipal development, small farm adaptive research, land sale guarantees, cooperative development, access road construction and improvement, small rural and artisan enterprises, and rural housing. Rather than take on all these activities directly and at once, INVEIRNO decided to handle certain services itself and to coordinate selected services with other institutions and agencies. At present, INVIERNO is providing agricultural credit, technical assistance, marketing assistance, and community action to its beneficiaries. Through support services by other public agencies, INVIERNO has promoted access road construction, infrastructure and municipal development, and research oriented to the development of technology appropriate for small farmers. Also, education, health services, and electrical power are provided under the Institute's coordination.

This strategy of integrating services is consistent with an observation resulting from the U.S. Agency for International Development (AID) 1973 review of its credit programs that: "Credit institutions working within an integrated program have a better overall success". At the same time, this strategy increases the demands on the institution's financial, administrative, and managerial resources and capabilities and may, in turn, reduce the numbers of clientele that can be reached in a given period of time.

In practice, the extent to which the various services have been provided by INVIERNO has varied. Credit has been given first priority, while most of the other services have been organized around and for the sake of the credit operations. This has not happened by planning or conceptual design. Rather, it reflects INVIERNO's attempts to get things moving, given its institutional constraints and political circumstances. Credit was a particularly difficult component, but it was the activity which most significantly influ-

enced the institution's image with the Government and with the public. However, there is danger that only borrowers will benefit from the program, and not other non-borrowing rural residents. INVIERNO is aware of this danger and is attempting to correct it by focusing on community action, and by incorporating the communities into the formulation of its operating plans. Some problems in integrating services at the local level have arisen due to the difficulty of coordinating operations with other public agencies. This was particularly true with marketing. Initially, INVIERNO signed a contract with another government agency for the marketing of basic grains produced by the small farmers, but the farmers chose not to market through the public agency, dealing instead with private intermediaries. As a result, INVIERNO was forced to look for other ways to assist the marketing of small farmer crops. It is now limiting its marketing aid to the dissemination of information about crop prices, hiring trucks for transport, and establishing contacts between buyers and sellers. In the future INVIERNO expects to promote on-farm storage to allow farmers to sell their crops at a time when prices are more favorable.

INVIERNO's general philosophy is to deal with the total needs of the rural resident at his doorstep or at least in his immediate area. Its intent is to assure that the services which may be necessary for an improvement in the level of living of the rural population will arrive at a time, and in a form, quantity and place, which can facilitate the rural residents' own self-help efforts. All of this is accomplished through multi-disciplinary mobile teams at local Development Centers (CEDE), usually located in market towns. This team normally is composed of an agricultural technician-extension agent (AGROMOC), an input and marketing specialist (CREDOMERC), and a community specialist.

INVIERNO's strategy has been to saturate any geographic area to be served by a CEDE in order to minimize operating costs. This gave special importance to the selection of the new localities to be served. An eligible locality must be situated within a 25 kilometer radius from a CEDE or SUB-CEDE (branch office), must have an all-weather access road (if not, building it will have high priority in INVIERNO's planning), must have agricultural potential, and must include at least 20 houses within a 5 kilometer radius. These criteria were selected so they could provide services at the lowest operational cost possible.

Program Management. A consensus has been emerging among development specialists to the effect that management is a critical factor in the success of any agricultural credit or integrated rural development program, especially in the delivery of services to the poor. This management is not "a thing apart", but becomes closely

intertwined with technical activities: it includes the implementation of a system for planning, methods of supervision, use of a systems approach in judging the resources required for service to the rural poor, the elaboration of operations manuals in order to introduce discipline into the various practices, and the training and assistance in realistic methods for organizing the poor. All this has been particularly important in the case of INVIERNO, as it is a large and complex program for the delivery of an integrated package of services to small farmers. Achievement of the institution's goals has placed very heavy demands on an efficient management system, and the quality of this system has been a key element in the relative success of the institution.

The main factor in managerial success has been the competence of INVIERNO's staff. Although pleased with the results of their efforts and with the appreciation by various observers, INVIERNO's managers and professionals have continued with their practices of rigorous internal evaluations, their search for better approaches and methods, and their desire to anticipate potential problems due to the expansion of their operations. One of INVIERNO's salient features has been the desire that its personnel be of the highest quality, both in education and competence. To assure this, INVIERNO has implemented a highly professional personnel system which combines a competitive salary scale, a liberal fringe benefit package, and an effective system for the selection and promotion of the personnel from within, which includes six-month individual employee performance evaluations. All INVIERNO positions are given job descriptions with their responsibilities and authorities defined, along with the minimum qualifications required of an incumbent. The attractive pay and this classification system has helped bring persons to INVIERNO with substantial academic training and prior work experience, in many cases much exceeding the minimum requirements. In turn, these high quality people have tended to stay at INVIERNO in view of the professional stimulation provided by the institution as well as its dynamism and innovative approaches. A high degree of professionalism is particularly evident throughout the institution. This is highly significant, given the continual problem for public institutions in low-income countries of keeping good people.

Planning has been given high priority throughout the institution, and a great deal of effort has been devoted towards achieving a clear definition of INVIERNO's philosophy, objectives and approaches. This planning function takes place at all levels of INVIERNO, primarily through planning meetings and planning records, as well as through a once-a-year overall planning exercise with community participation. Department and Division heads keep track of project objectives and individual program objectives through the use of individual standardized planning sheets. Each department sends in a narrative description each month to the Department of

Programming and Control. There has been an increasing use of PERT charting. Similar planning records are maintained at the Regional Office and CEDE levels.

Along with the planning and progress records, the key to planning has rested on a series of closely synchronized meetings at the Central Office, Regional Office and CEDE levels. Every other Monday the Central Executive Committee meets in Managua, both as a decision-making group and a planning body where short and long term strategies are discussed and agreed upon. This committee consists of INVIERNO's General Manager, two Vice-managers, Department and Program Directors, and all the Regional and CEDE Managers. In turn, the regional staff meets with the Regional Manager to learn about results of the Managua meeting and to provide the information resulting from the periodic meetings at each local CEDE. These synchronized meetings have been good devices, both for management and for a flow of information for planning and operations from the top down and the bottom up. INVIERNO is also critically aware of the importance of evaluation. Therefore, several elements have been introduced that will permit internal and external evaluations. In the institution's overall plan certain quantifiable goals have been established which have become benchmarks against which actual results can be measured.

Loan procedures. INVIERNO's agricultural credit component has been designed to address the problem of making credit available in small amounts to a fairly large number of small farmers, at reasonable costs, and adjusted to meet their needs. In this connection, INVIERNO has adopted several innovative concepts and procedures which, if successfully implemented, would be particularly relevant for other small farmer credit programs in developing countries.

The identification of potential beneficiaries is achieved through a "census" performed by the AGROMOCs in each one of the localities served. In effect, each locality is canvassed completely to explain the credit program and to ascertain the needs and desires of the residents for credit. This first step is a reflection of INVIERNO's philosophy of bringing the public sector services to the locality of every potential beneficiary. If during the census, a resident wishes to get a loan from INVIERNO, a two-page census form and a loan application appropriate for electronic processing are filled out, reflecting the interaction between the farmer and the AGROMOC. All of this basic information is later used in the computerized evaluation of the loan application; weights are accorded different borrower characteristics found by INVIERNO (or estimated) to be important. If the loan is approved, the amount of the loan is calculated and a loan contract, notification letter and enterprise budget are printed -- all electronically -- showing the dates of anticipated withdrawals of funds and the amounts to be financed for specified inputs.

This procedure has significantly reduced INVIERNO's administrative costs per loan. It has released CEDE-level personnel for activities other than loan processing, and it has eliminated many of the errors resulting from hand processing. Moreover, since all loan applications arrive at about the same time at the beginning of the planting season, INVIERNO would require a large number of trained staff to adequately process the applications within a reasonable period of time so that loans can be used for inputs when they are needed. Nevertheless, borrowers still complain about the excessive delays in loan approval and fund disbursement, even with computer use. A trend towards group lending has emerged as a means of further reducing costs and delays.

Presently, approximately two weeks after the loan forms have been sent to Managua, each CEDE receives computer lists of approved borrowers with loan and input amounts. Summary lists of credit and input needs by CEDE and region are easily prepared to assist in coordinating input purchases and delivery logistics, since INVIERNO delivers the cash to the farmer in each locality and at the same time it provides inputs which the farmers can buy if they so desire. Initially INVIERNO had little idea about what factors and weights were most appropriate for borrower selection. During the first planting season a set of fairly restrictive criteria for acceptance were programmed. These criteria are being modified as more lending experience is gained and analyzed.

A second INVIERNO innovation in small farm lending was the introduction of a line of credit. The plan was to establish a five-year line of credit, the amount depending upon the acreage controlled by the farmer and his needs. Fund disbursement would be made in subsequent planting seasons. This line of credit contributes to a reduction of a farmer's uncertainty about the performance characteristics of the credit program. It also helps to reduce administrative and other transaction costs, both for the borrower and INVIERNO, since the legal and other expenses associated with yearly applications and loan contracts are avoided. Further, the institution can maintain a single account for each borrower rather than keeping one account for each loan operation into which the borrower enters, as is done in many credit institutions. INVIERNO has had some legal and other problems in implementing lines of credit, however, so this technique is not yet widely used.

When INVIERNO provides all of its services locally, this certainly increases the institution's costs; but it does not necessarily increase the social costs associated with the provision of these services. It has been found that the costs to small farmers of obtaining credit from public agencies are usually very high. Non-interest costs can represent 12 to as much as 74 percent of the

amount of the loan, according to studies in Bangladesh and Brazil by Nehman and Adams. The sum of all of these individual costs of borrowing is very likely to be greater than INVIERNO's costs of reaching the borrowers, given the economies of scale and other administrative efficiencies achieved by the institution. Therefore, from a social point of view INVIERNO's strategy can be justified. In addition, if a significant reduction in administrative costs can be achieved through massive lending, then the strategy may become justified as financilly profitable to INVIERNO as well. The institution has been attempting to be self-sufficient in its banking program, and eventually expects to cover most of these costs with loan interest charges.

In summary, INVIERNO has established a loan application and credit-input delivery system designed to provide timely credit with associated off-farm inputs as cheaply as possible. Even so, problems have been encountered in making sure the inputs are actually available locally when the mobile team visits the locality to deliver the money. Multiple repeat visits to accomplish what could be done in one visit greatly increase delivery costs. INVIERNO is looking at ways of either improving the present system or finding other ways of delivering the credit and inputs.

Repayment by ability. Most credit specialists recognize a theoretical need to adjust loan repayment according to the repayment capacity of the farmer; but in practice this is not easy to put into operation. INVIERNO began experimenting with mechanisms which reflect the variability of agriculture, and thus, the small farmer's ability to repay a loan. Initially, INVIERNO estimated the farmer's repayment ability using a concept of income availability. An estimate of income available was based on estimated average yields and prices received in each area for the loan period in question, less an estimated amount for family maintenance. If available income were less than the estimated loan repayment obligation, the borrower would only be required to pay what it was estimated he could afford at that moment, and the balance due would be automatically carried forward. On the other hand, if income availability had been greater than the estimated loan repayment obligation, the borrower would have to pay the full estimated loan obligation plus 30 percent of the difference between what was available and what was due. This over-payment would be placed in an interest-bearing savings account in the client's name, to be withdrawn as he wishes.

This original concept of variable repayment would have been one of INVIERNO's most interesting innovations, because it helps protect both the farmer and INVIERNO against the risks and undertainty inherent in agriculture. Unfortunately, this concept turned out to be too ambitious and complicated for INVIERNO to handle in its form-

ative years. Therefore, the system was never implemented. In its place, a "minimum payment" due under normal conditions of production is calculated for each borrower and reported every three months. The borrower is expected to pay this amount within six months of the report; if not, he is considered to be under willful delinquency. However, if the borrowers have suffered considerable losses due to causes outside their control, the "minimum payment" is adjusted accordingly and the loan is restructured. The adjustment is automatic for individuals if an entire area is affected, or is made piecemeal on an individual basis for isolated problems. Presently, however, there is no operational mechanism for inducing a more rapid repayment during good years, as previously conceptualized.

It is too early to evaluate the final efficacy of the present loan collection methods. The danger persists that the delicate concept of variable repayment, although highly desirable, may be misunderstood by field personnel and farmers alike, or not be correctly implemented, leading the institution over time into financial difficulties. In fact, at the end of October, 1977, over 29 percent of the borrowers were late in their payments, which represented about 15 percent of the total amount outstanding. This illustrates the importance of analyzing the causes for delinquency if a variable loan payment system is to survive where the credit component is expected to be self-supporting. It is hoped that using "community boards" to help select borrowers and to assist in loan repayment will improve this record. INVIERNO also is considering rewarding a community with a donation for a visible community project when it achieves a certain repayment standard.

<u>Integrated technical package</u>. The lack of profitable investment opportunities for small farmers has been one of the most serious problems facing the majority of agricultural credit programs in developing countries. Even when profitable investments are available, the additional risk associated with the adoption of unfamiliar technologies often has been more than the small farmer is willing to accept. Such deficiencies can bring about major difficulties for a credit program reflected in high delinquency levels, followed by restructuring of loans, and the exclusion of a major portion of the target group from receiving additional credit over time.

INVIERNO has placed considerable emphasis on raising small farmer incomes through the adoption of new technology, and it has experimented with a number of ways of reaching this objective. The key person for developing and introducing new technology has been the AGROMOC, the primary and continuing link with the farmer. The technical recommendations of the AGROMOC are based on three data sources:

(i) experimental work previously carried out by the Ministry of Agriculture and now by the Nicaraguan Institute of Agricultural Technology (INTA);

(ii) results obtained from field test plots run by the AGROMOCs and from the demonstration-training plots operated by selected farmers; and

(iii) the experiences of the farmers themselves in their own plots.

The technical knowledge resulting from these three sources guides the AGROMOC's recommendations to the farmers. The AGROMOC uses the test and demonstration plots in his technical assistance activities by directly involving some of the farmers in operating the plots, through periodic field days to demonstrate methods and results, and through individual contacts and group meetings to discuss new agricultural innovations, recommendations and experiences. The voluntary collaborators, chosen among members of a locality with leadership potential when INVIERNO starts operation there, seem to have been used primarily as messengers to alert the community to meetings, field days, etc. These voluntary collaborating farmers, however, could also be trained to serve as an element in extending technical knowledge and assistance to neighboring farmers, a considerably less costly delivery mechanism if it could be initiated and made successful. A study of data from AGROMOC daily time-use reports showed that up to 56 percent of their time on extension activities has been associated with individual farm visits. This has resulted in high administrative costs, as well as a limitation on the number of farmers being reached, both of which are in direct conflict with program goals. As a consequence, INVIERNO is attempting to revert back to working with groups to correct this bias.

In 1977 there were two technological packages for farmers producing small grains. Package "A" was for the farmer with little or no prior experience in the use of credit for purchasing modern inputs. In this case the credit can be used to purchase improved seed, land rental, and to buy oxen, also for family maintenance. Major emphasis is placed on improved seed and weeding, water retention practices, and greater plant density. Package "B" is for the more experienced farmer; credit may be used for the items cited and also to finance hired labor, fertilizer, insecticides and other off-farm inputs. Soil samples are taken to guide fertilizer recommendations.

Typical crop budgets for these two alternatives for each of the major crops are prepared by the computer in the Central Office using the three previously mentioned sources of data. The limited number of technological packages is an obvious weakness in the program,

given the significant differences usually found among zones and farmers. Furthermore, the centralized system seems to have the disadvantage of building rigidity into the selection of the packages. At the same time, however, it greatly frees the AGROMOC and other field staff from the time-consuming tasks of filling out crop budgets by hand, as is done in most other small farm credit programs. In any case much of the same rigidity has been observed in most of the non-computerized locally operated systems where, due to time and other constraints, a "typical" crop or farm budget ends up being used as the basis for most loans.

The computerized system has two potential advantages: (1) A much wider range of technological packages could eventually be made available to the AGROMOC and farmers; and (2) if data on actual loan uses by item are fed back into the system, it would be possible to modify the budgets so that they could come very close to what the farmers actually do. In addition, once reliable census or sample data on farm yields are obtained, an analysis of yield and net income by technological package used would provide valuable insights as to the most appropriate technologies to recommend for raising small farmer incomes.

INVIERNO contemplates developing other packages of inputs and farm management practices which will be an improvement over present practices. This includes looking for ways to utilize the farm family's labor and other resources more effectively to raise income levels. Some delay was experienced in initiating research directly applicable to INVIERNO beneficiaries (contracted with another government agency); unless usable research results are forthcoming, this could be one of the weakest links in the integrated program. The institution is just beginning to evaluate the impact of its programs at the farm level. Farm record keeping case studies are being carried out in the two regions; periodic sample surveys and other data collection techniques are being utilized to complement the case studies. Soon, considerable information should be available on levels of technology adoption, changing cropping patterns, attitudes, and income levels, as well as other economic and social data.

Computerization. INVIERNO has made an intensive use of electronic data processing for its operations and management. In addition to using the computer to handle conventional administrative activities like cash flow analysis, payroll and budgets, INVIERNO also is attempting some highly innovative work in applying computer technology to programmatic areas. The separation of banking and nonbanking costs, for example, is an outstanding example of an effort to clearly define and measure the costs of the various programs implemented by the institution. Another use of the computer has been made in the area of recording the use of time by field workers. By cate-

gorizing the time each outreach worker spends, INVIERNO has been able to evaluate the working patterns and efficiency of its field personnel. Another source of important information which the computer handles cheaply has been the computerized analysis of the results of demonstration and test plots.

INVIERNO's most important and innovative use of the computer has been its ability to process a large number of individual small loans at a relatively reduced cost. One of the most important factors which has militated against extending credit to small farmers in most countries has been the high cost involved in processing their loan applications. With the use of the computer INVIERNO is attempting to make this loan processing cost-effective. At the same time it hopes to produce timely decisions with respect to loan authorizations: a computerized decision-making model enables the institution to handle and make judgement about a large volume of small loans in a short period of time. In addition, INVIERNO acquires an effective control over the transactions involved, guaranteeing the quality of the services offered to the beneficiaries and the financial viability of the institution. Finally, the nature of INVIERNO's operations make indispensable a continuous follow-up, evaluation and reprogramming, with the aim of making adjustments on the basis of field experience. The computer significantly facilitates all these procedures.

The use of the computer, however, may not be free of dangers and other disadvantages. One important area of potential problems is the coordination of the data processing activities at the Central Office with the needs and requirements of the AGROMOCs and other field staff. Problems may arise as a result of delays, insufficient understanding of the computerized procedures or of the resulting outputs, and outputs in a form not readily usable by the field staff in their daily activities. The computer could become an important bottleneck during certain peak periods, particularly just before loan disbursement. As reported, there have been important delays in the notification of the loan authorizations and in the disbursement of the loans, but these have been due more to problems of data collection in the field or coordination of field activities than to difficulties in the centralized computerized operations.

In the second place, although the computer greatly reduces the administrative burden at the local offices, it also increases the problems of communication between the field staff and the Central Office, and particularly between INVIERNO's personnel and the beneficiaries. There is also a danger that the computer may be viewed as a problem-solver, and that administrators may develop too much of a dependence on the system rather than on their own agile problem solving. But the computer and related systems cannot solve new or

unpredicted problems. Once the institution's management reacts to a new problem, however, it can process the information required for its solution with the use of the computer; and it can undertake computerized simulation and sensitivity analyses of alternative solutions in order to help choose the best one. A final limitation for adopting computerization in other countries relates to data transmittal. Nicaragua is a relatively small country with good road, telephone, and radio communication. Other countries may encounter overwhelming problems in transferring data for processing from field offices to the central office and back again within a reasonable time and with minimal error.

Conclusion

There can be no doubt that INVIERNO is an extremely innovative effort to solve the problems of the Nicaraguan small farmer, and that it has made extraordinary progress in outreach during its first few years of experience. The particular innovations that have been tried are described above, and further experiments will doubtless continue. Its main strength has been the quality of its management system and the competence of its professional staff. One is favorably impressed not only by the novel concepts introduced and by the sophistication of the procedures employed, but particularly by the rigorous internal evaluation efforts, the continuous search for better approaches and methods, and the ingenuity and energy with which new problems are solved.

[Extracted from a paper presented at the Second International Conference on Rural Finance Research Issues, August 29-September 1, 1979, in Calgary, Alberta, Canada.]

Comment -- The statistics on which this paper were based preceded the fall of the Somoza government. Operation of all aspects of the economy in Nicaragua was, of course, disrupted by the Civil War in 1978-79. It is worth noting that the new government has approved the INVIERNO program, and wishes to pursue it even more vigorously than before. The program has been renamed "Pro Campo", and many of the people working in it have changed, but its methods have not. Current plans are to extend it to all parts of the country. Ultimate results of this effort will depend on the outcome of some undecided questions, notably those affecting the evolution of the land reform.

Aspects of Money Lending In Northern Sudan

Martin W. Wilmington

[Village merchants and landowners, and persons with no other occupation, are found lending money to small farmers all over the developing world. Their interest rates tend to be very high, and they are often denounced by intellectuals and city dwellers. But their costs and risks are also high, and their services are adapted to client needs. This article gives the moneylender's side of the picture.]

Samuel Johnson once described the popular concept of the creditor as a man of evil appearance and intent, always eager to squeeze the last ounce of life out of the jovial, good-natured, charitable, and innocent borrower. While we hear much about the alleged profits and proclivities of the moneylender, we know little about his problems or the nature of the role he plays in society. Yet without an attempt to appreciate more fully his side of the story, it will be difficult to approach realistically the need for credit reform. It is frequently overlooked, for example, that many personal loans in Asia or Africa are made not for productive purposes but for such ostentations as lavish wedding feasts and dowries, on which no formal credit institution would extend credit to low-income borrowers but which nevertheless answer an urgent psychological need. No thought is given to the lack of debtor ethics which makes collection a strenuous and costly affair. Nothing is said about "bad debts" and the annual losses they cause the moneylender in countries where most borrowers are only inches removed from absolute destitution; high residential mobility -- particularly between

Wilmington taught economics and finance at Pace College, New York

city and country -- produces a high incidence of debt evasion; and low life expectancy coupled with the general absence of insurance makes every medium and long-term debt a special hazard. No consideration is given as to where the moneylenders themselves obtain funds for business: they, in turn, may have borrowed at the exorbitant rates from a tight capital market, or abstracted funds from profitable pursuits in other lines.

The impression is often conveyed that moneylenders get enormously wealthy from profits extracted from the poor. Yet the apparparent wealth of such lenders may come from occupations other than lending, which is often a subsidiary business of a merchant or landowner. Moreover, a great many moneylenders, despite the exorbitant rates of interest reported, do not seem to lead the prosperous life one might expect. Finally, an answer must be given to a phenomenon which has puzzled many reform-minded observers: Why does it happen so frequently that private moneylenders enjoy the continued patronage of poor rural and city workmen, even after socially oriented credit facilities managed by cooperatives or the state have been made available to them?

Bearing in mind the need for a more balanced study of the economics of the moneylending profession, I made a preliminary investigation of the problem during a stay in the Sudan. The information presented applies to the Northern Sudan, populated by Arab-speaking groups of predominantly Islamic faith; it may have some validity for the Middle East as a whole. To get the moneylender's side of the story is no easy matter. Most of the time he keeps no detailed records and has only the vaguest notion of the relationship between revenue, costs, and yields. His own calculations are based on hunches and rules of thumb rather than conversion tables. If he does have the facts and know-how to answer a Western-style questionnaire, he is too suspicious and secretive to bare his breast. My principal source of guidance, therefore, was government officials known to be familiar with rural problems of the country. One of them had the additional advantage of having been reared in the house of a moneylender and thus having observed the family business at close range.

Pattern of borrowing. Rural credit in the Northern Sudan is by and large in the hands of merchants and, to a smaller extent, landowners. In contrast to India and Pakistan, there are few people in the Sudan who make moneylending to cultivators their exclusive or principal business. Major banks like Barclays, the Ottoman Bank, the Arab Bank, and Credit Lyonnais have branches in the Sudan but steer clear of the small farmer.

Generally, credit is extended by the merchant-lender in the form of advances in money or kind against the next crop, an ancient system called *shayl*. Several types of *shayl* are practiced. The oldest form is an advance of grain or seed valued at a price substantially above the estimated price at the next harvest. The borrower must settle the loan by returning at harvest time enough grain to make up the money equivalent of the loan. If a good crop follows a bad crop, with a resulting drop in market prices, the lender may get back as much as five to six times the volume of goods he loaned out. Another type of arrangement under *shayl* is more in the nature of a middleman's service. Cultivators may find it difficult to market their crops for lack of funds to purchase sacks and meet transportation costs. The merchant will agree to take over the crop at the market price less an amount approximating the rate of short-term advances on crops. Still another form of *shayl*, which will serve as an example here, involves the advance of money against future crops. At the beginning of the season the cultivator will solicit a sum of money (or sometimes consumer goods) to be repaid in a specified quantity of produce, say an *ardeb* (5.6 bushels) of beans. The lender will set the amount to be lent against the future delivery substantially below the last harvest price or the anticipated value at the forthcoming harvest, whichever is lower. Thus, when the borrower surrenders the pledged quantity of beans, endowed with the higher valuation of the market, the lender, if his "hunch" was correct, should derive a considerable profit from the operation, namely the difference between the harvest value of the commodity pledged and the *shayl* value set by him.

How high is the rate of interest the lender expects? The amount varies, of course, from year to year depending on price fluctuations. Probably the best indication of what the lender expects to receive as "interest" comes from government data collected when grain prices were relatively stable thanks to government controls, so that the lender could foresee with greater assurance what the next harvest price would be. A typical transaction (reported by Daud Abdul Latif) was as follows:

Value of *ardeb* of beans, end of season...Egyptian	P.T. 360
Shayl value of beans, start of season....	- P.T. 200
Gross profit of lender	P.T. 160

In other words, at the start of the crop year the borrower received 200 P.T. on loan. About ten months later, at harvest time, he was required either to surrender an *ardeb* of newly harvested beans or pay the current market price therefor. Owing to government controls, the lender probably knew that the harvest price would be 360 P.T.; the borrower therefore was expected to pay

160 P.T. for a ten-month loan of 200 P.T. Converted on a per annum basis, this would mean a rate of interest of approximately 100 percent.

The Moneylender's Problems

What arguments could the moneylender present if called upon -- and willing -- to justify this high rate of interest? The case cited above involved a village merchant engaged in money-lending as a subsidiary business. In such instances the compensation derived from the use of capital for loans to cultivators -- rather than retail trading -- must be in some relation to the yield of capital investment in retail trading. Profit rates from wholesale and retail trade in the Sudan are relatively high: markups may be as much as 50 percent or over. What is more, the turnover of capital in trading is rapid; a merchant may roll over his capital as many as five times during one year. If he immobilizes a certain amount of his capital, say 100 piasters, by lending it out to a cultivator for a year, he may forgo the opportunity to earn a substantial return on several times the amount of the loan, say 500 piasters. The rate of interest on the loan, therefore, will reflect the alternative profit in trading thus sacrificed. This will be true even though he may be lending out idle capital, for the year-long immobilization of idle funds may deprive the lender of trading opportunities that turn up in two or three months. On the other hand, social pressures, as described below, and the desire to maintain a large market for his trading business will induce him to use some of his capital for loans to his cultivator-customers despite the beckoning of other trading ventures.

Secondly, protection must be provided against a miscalculation of market conditions at the next harvest. If, because of a bumper crop, the price of beans should drop below the *shayl* price, the quantity delivered by the borrower in repayment of his debt will be worth less than the amount of the loan. The discount must therefore be adequate to cover the wide price range within which agricultural commodities tend to fluctuate, and provide a cushion against losses from unforeseen price recessions in past as well as future years. So also a crop failure, although it drives up commodity prices, may be detrimental to the moneylender, for the cultivator may not reap enough to spare an *ardeb* of produce for loan repayment. He needs, after all, a minimum of grain for food and sowing; and the lender would incur communal ostracism if he tried to press his claim at the price of starvation or dispossession of his client. If there is a succession of bad crops, the lender's claim may remain uncollected for several years.

Often the condition of the cultivator after a bad harvest may be such that he has to borrow still more in order to feed family and

flock and continue cultivation. The lender then will have to increase his investment in an already delinquent client if he wants to salvage his stake at all. To offset the loss, the *shayl* fee is compounded upon renewal or increase of the outstanding loans to double and triple the original rate. A vicious circle starts, and soon lifts the debt to astronomical levels. The borrower now may find himself enmeshed in a lifelong pattern of annual produce deliveries to the lender, only to be terminated by his death or unusual market conditions. (During World War II a record demand for Sudanese grain freed many cultivators from debt burdens endured for decades.) This "life-long servitude" of the rural debtor demonstrates two facts: (1) that the collection of debts in full after the lapse of contractual terms is no easy matter; and (2) that the high contractual rates of interest decried in many studies of moneylending are often not collected in full.

The Sudanese cultivator, for his part, often does not enter into debt with the notion that debt is something distateful and a moral obligation to be discharged as soon as possible. He may not save, or plan for a more modest wedding or dowry, because of a debt load. On the contrary, he may exert much resourcefulness to devise alibis for avoiding payment, and find means of withholding or concealing his crop from the grasp of the lender -- like his counterpart in some other parts of the world. Moreover, many cultivators manage to extricate themselves from their debt by joining the thousands of their countrymen who have found employment in Egypt. Once away on his northern trek, the debtor can seldom be traced; he will soon be swallowed in the vast crowds of Cairo, where he starts a new existence with a new occupation and a new wife. Debt evasion, therefore, is a risk of special magnitude to be calculated in setting the *shayl* rate.

Much has been said about the lack of effectiveness of laws designed to protect the debtor. There are, of course, courts in the Sudan to enforce laws against usury, but the debtor knows that once he appeals to the tribunal he may never get a loan again in his community. The lenders are a tightly-knit guild; they not only abstain from competing against each other by the offer of lower interest rates, but promptly join in the boycott of any cultivator who seeks his day in court. But the lender also finds little solace in the courts, although the law affords him certain rights. He is reluctant to go to court lest he awaken the borrowers to the existence of legal recourse. He knows that he can recover in court only a small part of the claim which he considers justified, since the law limits the rate of interest. As in other parts of the Middle East, land and property titles are often too confused to offer a reasonable prospect of success to foreclosure proceedings. Moreover, the lender may himself run the danger of a communal boycott of his other

business if he does go through with foreclosure of a poor cultivator's land.

Services Offered by the Moneylender

Not all the interest collected by the creditor is profit and risk insurance. Certain expenses and outlays have to be recovered, certain services rendered to the borrower must be compensated. Often the lender pays out of his own pocket the taxes and local imposts due on the crop delivered by the borrower. Often he must supply sacks and transportation to effect the removal of *shayl* produce from the borrower's field. He must store the delivered produce pending its disposal on the market and again pay the cost of transportation to the market; expenses and losses due to storage loom large among the many hazards of the region. A staff must be maintained to do all this work and roam the countryside on collection and check-up duty.

Frequently, the creditor uses the services of a "guarantor." Theoretically, the guarantor -- usually a man of better financial position than the borrower and linked to the lender by an informal arrangement to perform this chore whenever needed -- is brought into the picture as a cosigner of a loan granted to a borrower weak in resources and credit standing. However, he is not really expected to be responsible for the loan in case of default. He is used first of all to witness the transaction itself if the borrower cannot sign his name, and secondly as a means of impressing the borrower with the seriousness of his obligation. If default does occur, the guarantor will be sent to exert additional pressure on the delinquent or ascertain the validity of his excuses. If the borrower's plea is accepted, the guarantor will merely be required to cosign a loan renewal without any firming in his commitment. For all this he is paid a commission by the lender; thus another expense burdens the interest collected. (In some cases the borrower may also be forced to compensate the guarantor, usually by doing some work for him.)

Some of the "services" which the creditor supplies are technical; for instance, he will often supervise and advise the cultivator during the crop season and at harvest time so that the work is done with care and efficiency compatible with the lender's stake. (Supervision at harvest time is also intended to make sure that none of the debtors conceal, or abscond with, the mortgaged crop.) Other services are of a nature which transcend the immediate commercial relationship between lender and borrower. By communal tradition the borrower is not merely a "client" but in many ways a social responsibility of the lender. The latter may be expected to lend extra money for medical emergencies, weddings, birth ceremonies, etc., regardless of the status of outstanding loans. It has already been mentioned that the lender must, under pain of communal ostracism,

make further loans to a delinquent cultivator -- even though he might be ready to write off the debt -- if the cultivator's livelihood depends on it. This is but one aspect of the moral obligation which moneylenders by tradition and sometimes also by inclination accept once a steady credit relationship has been established. Lenders are known to have continued making interest-free loans to old customers long after they have retired from business, knowing that the cultivator had come to depend on the annual recurrence of the loan and would perish without it. Sometimes they will set aside money for the specific purpose of continuing certain more or less charitable loans to old clients, and may pass on this commitment to their heirs.

Finally we come to another aspect of the lender-borrower relationship in the Sudan and other parts of the Middle East that is well known yet often forgotten. In accordance with traditional practices fostered by the Islamic prohibition of interest, the lender considers himself not a banker but a partner of the borrower. Even the Western world has no clear concept as to what the "proper" reward of the purveyor of equity capital in a given risk venture should be. One may argue in reference to the Sudanese lender that he labels himself a partner only to circumvent the laws of state and religion; yet when one considers the many social and communal obligations which surround him one can hardly call him a "lender" in the Western sense.

Conclusion

Such, then, would be the arguments adduced by a Sudanese moneylender in justification of his business practices. It is unfortunate that no actual business accounts were accessible for study so as to make possible the presentation of the actual profits and losses of moneylending; but in view of the many intangibles in the transaction between lender and borrower, it is doubtful whether figures could tell the whole story. Government officials recognize a need for vigorous programs to provide rural communities with inexpensive, socially orientated credit facilities aimed at displacing the private lender. But they know that such reform cannot succeed without changing some of the cultivator's modes of living and thinking. They know that it will be difficult to replace the intimate knowledge, the social niche, the supervisory work in lending and recovering loans which the village merchant can give. They know that city banks would laugh off most of the loan applications the rural moneylender accepts every day as a matter of course. They know that even at their most charitable level, state and cooperative credit agencies may find it difficult to render the "social" services which moneylenders often give to their client. Nor can they easily cope with the rural borrower's ingrained distrust and dislike

of institutions and red tape as effectively as the moneylender has done for centuries with his personal and informal touch.

Attempts to provide the rural dweller with credit facilities devoid of the well-advertised excesses of private moneylending have very often been disappointing. Some will ascribe this to ignorance and fear. But quite a few thoughtful observers tend to suspect that the reason may be the farmers' appreciation of a relationship whose full extent no accounting by double entry can show.

[Extracted from The Middle East Journal Vol. IX, 1955, pp. 139-46. Published by the Middle East Institute, Washington, D.C.]

The Pitfalls of Specialized Farm Credit Institutions in Low-Income Countries

J. D. Von Pischke

[Why are specialized farm credit institutions founded in low-income countries, and why do they frequently founder? This phenomenon of development finance is explored by analyzing their performance problems, using financial logic and elements of political economy.]

Specialized farm credit institutions (SFCI) primarily engage in the provision of loans to persons undertaking agricultural production. They have names like Agricultural Development Bank, Agricultural Finance Corporation, Rural Development Bank, Agricultural Credit Corporation, Supervised Credit Agency, Land Bank and similar titles. In comparison with other financial institutions, their distinguishing features are a loan portfolio consisting almost entirely of agricultural loans, and a narrow range of financial services offered. For example, SFCI do not on any significant scale accept savings deposits, provide money transfer services, store valuables for safekeeping, or serve as fiduciaries, except when these functions are required in the processing of loan applications and in loan administration.

SFCI are established by governments in low-income countries to provide financial assistance for expanding agricultural production. They may cater to specific target groups of farmers based on farm sizes, or on their crops; and they are sometimes linked with land tenure classifications or reforms. Their services may be directed towards beneficiaries of projects for agricultural settlement, or compre-

Mr. Von Pischke is a financial analyst with the World Bank, Washington, D.C.

hensive rural area development. These institutions are usually expected to provide an impetus to agricultural innovation, and to promote certain social aspects of rural development policy - often in the small-farm subsector. Development assistance from foreign donor agencies often plays an important role in the design, establishment, financing and staffing of specialized farm credit institutions, and in their reorganization and rehabilitation. The World Bank's cumulative lending for farm credit approximated US $2.1 billion by 1978, and very substantial sums have been contributed by U.S. AID and the European donors as well as the regional development banks. Much of this agricultural lending has been directed into SFCI.

Specialized farm credit institutions in low-income countries have a checkered record as financial intermediaries. Their efforts to achieve institutional and financial viability and to expand their clientele encounter more complications than those of more diversified lenders because of the vagaries of agricultural production and prices, and also because a certain portion of their activities have more in common with social welfare activities than with commercial practice. Losses appear to be larger than would be expected from normal credit institutions. These lenders often find it difficult to achieve loan recovery levels sufficient to break even financially.

Why Are SFCI Created?

The assumptions behind the creation of SFCI are that the agricultural sector (or the subsector in question) is not well served by existing credit institutions, and that most rural families (or a target group in question) do not have direct access to financial services provided by the formal, usually urban-based institutions. It is assumed that the formal financial market, although not highly developed, is loss-avoiding, rational, and workably competitive. It is also assumed that policy makers believe that supplying credit for agricultural purposes, or for the subsector -- i.e., the cultivators or target group in question -- would be advantageous. This belief consists of four related assumptions or ways of viewing rural people, the state of agriculture, the requisites of rural development and the role of government. The first is that "farmers are poor." Of all target group characteristics, poverty is singled out as of primary interest. The second, "the farm credit need-creed", holds that little agricultural innovation or progress can occur without access to credit, so that poor farmers "need" credit. The third is the axiom that government should promote rural development or target group welfare. The fourth is that "supply-leading finance" can stimulate agricultural and rural development and contribute to target group productivity. This term, evidently coined by Hugh Patrick in 1966, suggests the antithesis of the more usual observation that, "Where enterprise leads, finance follows". Supply-leading finance

consists in providing funds in advance of demand in an effort to stimulate risk taking by borrowers in socially useful activities. In agriculture it is based on the assumption that when credit is tied to new practices, such as improved inputs or a new crop, it will accelerate the adoption of an innovation by the target group of intended borrowers.

The "public sector farm credit complex" thus defines the rural development problem in terms of the poverty of farmers and their lack of access to credit for specified purposes, finds the problem one which ought to be solved through public sector intervention, and specifies credit as a medium through which political initiative may be exercised. Supply-leading finance responds to the perceived poverty of farmers as well as to the belief that access to credit is necessary and will lead to an acceptable rate of material progress.

Interaction of Interest Rates and Access

The public sector farm credit complex has produced advocacy of cheap farm credit. Its proponents state that credit should be provided at a "reasonable" rate of interest for purposes which are considered socially and economically imperative, and for target groups viewed as poor and having little alternative but to use credit if they seek to progress. Since informal market interest rates -- i.e., those charged by traders or other local moneylenders, but excluding kinship and friendship loans -- are high compared to those found in formal markets, the possibility of involving informal lenders in the solution to the problem defined by the public sector farm credit complex is not seriously considered; and this would not be feasible within the low interest rate structure proposed, as their costs would be too high.

What constitutes a "reasonable" rate depends upon local circumstances. Proposals often advocate loan rates like those that commercial banks charge on loans to commerce and industry. One argument raised against charging higher rates for agriculture is that it is objectionable to charge a high rate to the most disadvantaged people in society. A similar position is that low rates of interest help to compensate farmers for their losses of income from government price ceilings on food products (to help consumers). The usual result is agricultural interest rates below or roughly equal to the going rates on loans to other major sectors, or to individuals not dependent upon agricultural incomes.

Low formal sector interest rates on the types of loans most useful to rural people end, paradoxically, by restricting their access to formal sector financial services. Rural customers at low levels of financial activity are a costly market for a lender to serve.

They tend to deal in small transactions, which are relatively costly for a formal sector institution to process. They frequently are scattered geographically in areas with poor communications, making loan administration difficult. These factors inhibit the achievement of economies of scale by the lenders because of the small size of the market around a rural office. Rural people may not be accustomed to modern commercial practices, and often are not so concerned about loan due dates as other customers, which raises the lender's costs of loan and liquidity portfolio management. For deposit-taking institutions a clientele of small depositors, who conduct business in cash rather than by some form of payment order, requires that offices maintain relatively high levels of cash. Cash kept to meet depositors' demands earns no interest, adding to the costs of serving these clients.

The rural economy fluctuates more widely than many other types of financial activity. The marketed or cash-generating portion of agricultural output is subject to even greater uncertainty, as it is a residual left after the relatively constant subsistence requirements of farm families are satisfied. This variability in income tends to reduce lenders' evaluation of the debt capacity of the target group, which in effect is based on that portion of expected future resources that would be available for loan repayment in situations of reasonably expected adversity. Such situations include a certain proportion of poor harvests due to natural factors, low prices, and failures in the marketing system's capacity to absorb produce. Lenders' rationale rests on the requirement to meet the demands of their depositors and other creditors. An unpredictable stream of loan repayment collections increases lenders' liquidity requirements, which raises their costs and reduces the supply of funds they are willing to lend.

Uncertainty concerning the amount of a borrower's future cash flow which will be available to service debt is viewed by the lender as a credit risk. One determinant of willingness to bear this risk is the interest rate, which affects the income lenders can expect from the class of transaction concerned. Loans involving substantial degrees of uncertainty tend to be avoided by lenders unless they can charge high interest rates. When interest rates (used here to denote all fees levied by lenders) are kept low, lenders are not encouraged to expand their markets into activities which incur higher costs -- including the costs of greater uncertainty. A number of institutional factors inhibit lenders from raising rates selectively for individual borrowers to offset the costs of accommodating the more risky loan applicants. These include usury laws, the danger of increased political exposure, the size of the increases required, possible losses in economies of standardization of lending terms, and the costs of obtaining the information and expertise

necessary to contain the risks of marginal business. Low rates thus encourage lenders to stringently ration credit according to commercial criteria of credit-worthiness.

The stringent credit rationing by existing financial institutions results in severely restricted rural access to financial services. This is seen in the paucity of rural offices of banks; in loan security demands beyond the capacity of most rural households; in minimum transaction sizes and minimum deposit account balance requirements which are high relative to transactions and incomes normal for rural areas; and in other arrangements or requirements imposing significant transactions costs on those seeking access to formal sector financial services. Adherents to the "public sector farm credit complex" perceive in this situation grounds for remedial government intervention by establishing a special-purpose farm credit institution. This lender is intended to be used to overcome alleged weaknesses in market performance, and is therefore not designed to be dependent upon market resources. It is funded through the national treasury -- frequently with support from external nonmarket sources such as foreign aid agencies.

By definition, a specialized farm credit institution is highly selective in the types of financial services it provides, operating on only one side of the rural financial market. Credit access is considered the primary problem, and so deposit-taking and money transfer services are typically not developed. Rural savings capacities and liquid resources are usually thought to be small. Institutions already in place, such as post office savings banks or commercial banks and cooperatives, may be thought to be providing adequate financial services outside the credit sphere. Policy makers may not see any advantages in replicating facilities or stimulating competition for rural deposits or money transfers. In addition, these services require managerial and accounting performance of a higher order than those of loan disbursement, and there are merits in opting for simplicity initially.

Effects of One-Sided Intervention in Rural Finance

Intervention solely on the lending side of the rural financial market has consequences which are frequently overlooked. It tends to fragment these savings further: the credit channels are unrelated to the savings channels, and make little direct contribution to stimulating rural savings. Such intervention may encourage a popular belief that formal sector credit is essential, or is at least the most feasible means of progress, a view which could prevail at the expense of traditions of self-help and self-finance, and of the development of informal financial mechanisms such as rotating savings and credit associations.

Most importantly, dependence upon the national treasury and external donors limits SFCI access to market funds, and to the local information that it would have if it performed other roles than that of supplier of funds. Lack of such access results in alienation of the institution from the communities it serves. Alienation stems from inability to act as a rural financial institution, intermediating between rural savers and borrowers, rather than merely serving as a one-way link between the government and rural sectors. Rural people are not regarded by SFCI as a market to be developed, but are seen as poor, exploited or economically incompetent people requiring assistance. Rural people, in turn, do not view SFCI as something of their own, but rather as a benevolent instrusion to be exploited. In these circumstances a specialized farm credit institution is not well positioned to learn about rural financial flows, behavior and local priorities -- knowledge which is available only to those who enjoy sufficient confidence and operate on both sides of rural financial markets. Lacking such information and insight, and divorced from the context required to view finance broadly or creatively, SFCI management can develop only limited decision-making expertise. SFCI are not in a position to be stimulated by either the discipline imposed or the opportunities offered by market participation.

Without detailed information about the mechanics of rural finances, and limited by budgetary and operating constraints imposed by government sponsors, the specialized farm credit institutions generally are forced to allocate or ration credit by methods different from the commercial criteria applied by other financial sector intermediaries, such as commercial banks. Political criteria of some sort, broadly defined, are inherent in farm credit programs when designed by governments and development assistance agencies seeking to promote the welfare of target groups selected by non-market criteria.

Credit rationing by SFCI tends to take two forms, which may be termed intensive and extensive. Intensive credit rationing involves the identification of a relatively small target group, and the provision to members of that group of amounts of credit which are large in relation to the existing scope of their operations. For example, a farmer with two local cows may be given a loan to buy several high grade or exotic cows. A small farmer planting local plant varieties and using only a little organic fertilizer may be issued credit, possibly in kind, to plant his entire holding with high-yielding varieties nourished by chemical fertilizers. A farmer using bullocks for draft power may be accorded a loan to purchase a tractor. Or smallholders without a cash crop may receive tobacco planting materials on credit, plus a loan to construct a curing shed.

Intensive credit rationing has features attractive to aid agencies, and it is often found in externally funded SFCI activities. The usual objective of intensive credit rationing is to increase agricultural production and the incomes of borrowers through technological innovation. Because the size of the loan is such that borrowers could not reasonably be expected to repay it with their pre-loan cash flow, loan repayment must come from an increased cash flow to be generated by the loan-supported investment. Credit allocation under these circumstances tends to be quite selective in the choice of borrowers, and elaborate mechanisms using farm budgets are frequently employed by lenders to determine which farmers will qualify. An assumption underlying intensive credit rationing is that lack of finance is the binding constraint to increased production and augmented farm incomes. If so, this implies that all other elements essential to the realization of these objectives, including the ability to accomodate the uncertainties involved, are in place, or that they can be provided as an adjunct to credit and can be rendered operative by finance. Intensively rationed credit is supply-leading finance *par excellence*.

Extensive credit rationing is motivated by considerations of increasing credit access as well as production. Credit is allocated extensively to large numbers of farmers in broad target groups. For example, all members in good standing of a cooperative may have access to seed and fertilizer loans. All commercial growers of wheat having land titles may be eligible for production loans. Within SFCI budget or balance-sheet constraints, however, broad access implies relatively small loans to numerous borrowers. Loan limits under extensive rationing are frequently specified in terms of rules of thumb or standard amounts per hectare of credit-supported enterprises, in contrast to the more complicated derivation of loan limits from farm budgets used for intensive credit rationing. Extensive rationing is most frequently found in seasonal input credits. Small amounts are issued to each borrower, satisfying the production-oriented bias of program planners while also inspiring broad appeal which is politically desirable. Programs using extensive rationing are usually funded by governments without support from donors except in donor-supported area development projects, in certain aid for cooperatives, and in farm credit systems funded through centralized rediscounting agencies.

Each variety of stringent credit rationing under political criteria contains potential seeds of its own financial destruction. These seeds take root to the extent that politics produces extremes in credit rationing which overwhelm financial considerations. Programs with either highly intensive or highly extensive rationing self-destruct most rapidly, other things being equal.

Intensively rationed credit attempts to perform the function of equity or ownership capital in absorbing the impact of uncertainty. Intensively rationed loans are large relative to the financial status of the borrower, impose relatively large fixed debt service burdens, and change the on-farm factor mix significantly through the addition of higher levels of technology. Such loans can push the borrower's finances beyond his managerial and risk-bearing capabilities, especially during the critical initial learning period of adaptation to credit-supported change. Adversity can be reasonably anticipated in agriculture generally and especially in the implementation of new technologies. In periods of adversity, borrowers may find it difficult to meet debt-servicing obligations. The new activity may not generate sufficient cash flow to repay the loan which permitted its adoption. Delinquency in repayment easily results. Borrowers, however, may not regard transgression of government SFCI loan contracts very seriously: they may accept the public sector farm credit complex and view the lender as an alien institution with access to the tremendous resources of government.

Extensive credit rationing can also lead to financial problems. In promoting wide access to credit, lenders offer it to some borrowers who are not in a position to use it wisely, or who have little intention of repaying, or who are so exposed to uncertainty or so close to subsistence that even small repayment obligations assume major proportions. In these cases, an accumulation of arrears on the lenders' books is probable. For others who borrowed with the expectation that their agricultural incomes would be increased, the small sums of extensively rationed credit may present limitations. Prescribed husbandry practices which lenders intend to support may be subject to indivisibilities far beyond the actual loan size. For example, the loan may be small compared to the financial requirements of improved input packages, which can lead to incomplete adoption of the package with disappointing results. Improved seeds without enough fertilizer, for example, may not perform much better than traditional varieties. In these cases the borrower may not produce an incremental cash flow sufficient for loan repayment. Access to extensively rationed credit, therefore, does not necessarily stimulate adoption; and the loans may be too trifling to engender commitment to either their productive use or repayment.

Rationing by political criteria where borrowers are a favored faction easily leads to poor loan discipline, which can include delinquency, deceit and diversion. All these constitute a breach of a loan contract. Delinquency denotes the failure to repay on time, and inability or unwillingness to undertake repayment rise as credit rationing becomes increasingly intensive or extensive. Deceit arises because borrowers have an incentive to circumvent the rules of the game, especially rules made by a lender alien to them

and thought to have huge financial resources, (presumably rationed according to political criteria). Incentives to build a good credit rating are lacking, especially in the early years of an institution when its permanency and efficiency have yet to be demonstrated.

Some of the ways of circumventing loan limits per hectare under extensive rationing are to apply for credit for a larger area than will be cultivated, or to borrow simultaneously under different names. Another is to borrow using a different name each season. If loan repayments are deducted at source from delivery proceeds, there is an incentive to borrow and deliver under different names, or to use other delivery agents. These tactics are often successful when loan supervision and records are not finely tuned. The relatively large size of intensively rationed loans may tempt the borrower to divert a portion for purposes not envisaged by the lender, especially if the borrower is not entirely comfortable with the leap in risk and managerial demands which agreed loan use involves. Loan-supported purchases or disbursements in kind may be resold for immediate cash, or fictitious invoices may be submitted by accommodating suppliers. Diversion is probably even more common under extensive rationing, especially when loans are disbursed in cash.

Repercussions of poor loan discipline for the SFCI: Poor loan discipline impairs SFCI development. Funds which would have become available for relending as outstanding loans mature are locked up as arrears. As arrears accumulate, SFCI resources fail to revolve full circle. Potential new borrowers may increasingly find their access to credit delayed, restricted or denied because of the declining liquidity of the lender. When funds available for lending decline, intensively rationed credit becomes available to fewer new borrowers. Lenders may restrict access still further by increasing the average loan size to lower costs in loan administration, thus catering to an increasingly select group of relatively low-risk, large borrowers. Lenders of extensively rationed credit, on the other hand, may maintain broad access by reducing average loan size. The causes of arrears may be fortified as these loans become increasingly trivial, especially in real terms when inflation raises the costs of modern husbandry.

Arrears have an opportunity cost. Funds that are not repaid cannot be lent at interest. Day-to-day collection problems consume the time of lenders' scarce managerial personnel, often at the expense of activities requiring a long time horizon such as planning, the development of management information systems, staff training, and designing more effective services for rural people. The accumulation of arrears and associated poor financial performance may demoralize staff members who have a financial or accounting

outlook, making it even more unlikely that the institution could become financially efficient. In the rural communities affected, overcoming the reputation of poor loan discipline by government lenders is difficult and has its own cost. Private financial intermediaries outside the state sector may be deterred from serving the poor because of bad repayment habits. They may be increasingly reluctant to extend credit in experimental or innovative ways because of the heightened political sensitivity surrounding the enforcement of rural loan contracts.

Furthermore, the achievement of development targets may be hindered by poor loan discipline. Defaulters, originally considered as poor farmers deserving financial assistance, are placed in an adversary position against their financial partner in development; the flow of communication between borrower and lender is constricted. A basis for distrust is created between borrowers and rural development administrators, extension agents and SFCI staff. Distrust inhibits all rural development programs by making consensus and cooperative action more difficult to achieve, or by requiring the exercise of great force for the successful implementation of programs involving rural participation. Attempts to reduce defaults by extra-legal administrative recourse against defaulters might have some success, but it increases the probability of arbitrary action against rural people and adds to distrust.

Widespread unapprehended default demonstrates to rural people that government is not able or not willing to enforce contracts. But cases taken to court by SFCI to obtain enforcement may strain the ability of courts to dispense justice, especially if defaulters are numerous. The legal force of other contracts may be compromised by situations created by loan defaults, which could retard commercial advance and the contribution this makes to rural development. The accumulation of arrears also makes SFCI more vulnerable to political interference. Those who formed the institution to assist the rural poor and gain popularity are seldom enthusiastic about seeing their creation expropriate rural property, or use a black list of defaulters to be denied further credit. Interference may be across the board, forcing SFCI to permit all defaulters to take a longer free ride; or selective, favoring certain groups or individuals. Default may also be a source of conflict among rural people between those who strain themselves to repay and those who don't and fail to suffer for it. The selective nature of credit access may be magnified by selective default "privileges", i.e., by uneven efforts to enforce loan discipline. To the extent that the pattern of default mirrors the rural power structure, equity is violated by manipulation of collection activities. Thus, the initial concern for access when expressed through an inappropriate medium can end by violating the concern for equity.

The Future of the Public Sector Farm Credit Programs

The preceding description, while accenting the negative possibilities, nevertheless reflects the experience of SFCI in a wide range of countries in one degree or another. Some programs are more severely affected than others, but few can claim a complete immunity to the dangers concerned.

In view of the problems which plague specialized farm credit institutions in low-income countries, what is their future course? One certainty is that agricultural and rural development programs will continue to receive large amounts of funds from their sponsor governments and foreign aid donors because of their economic and political appeal, and much of this will go into credit. Less certain is the survival of particular SFCI, and the public sector farm credit complex in general. Four major influences may work against it. First, it will be rendered irrelevant in some countries where strong centralized control of agricultural production and of rural people, and the transformation of the formal financial sector into a set of accounts for the planning authority can eclipse the concerns of more gradual reformers. Second, rural development breakthroughs not involving supply-leading finance are likely to divert attention from the credit complex. There are several possibilities of this kind.

Third, the intellectual position of the complex will be eroded in some degree by trends apparent in recent research or rural financial markets. Assumptions which are increasingly challenged by empirical data are: that rural people are unable to save; that rural financial liqudity is negligible; that the informal credit market is characterized by "usurious" rates of interest; and that specialized farm credit institutions and low interest rates are low-cost government activities serving the best interests of rural people. Finally, the complex can be undermined by the practical success of farm credit suppliers which operate effectively in financial terms in ways which are at odds with the complex. These could include aggressive efforts to mobilize target group deposits, and techniques of support which concentrate on building viable financial institutions not dependent on subsidy, as opposed to low interest rates for target groups.

[Adapted from an unpublished paper. The views expressed are those of the author, and should not be attributed to the World Bank.]

Editorial Comment: This presentation has concentrated on the shortcomings in small farmer credit institutions as they often operate.

The dangers described are all too evident in the actual record of SFCI in a variety of countries. It seems worthwhile to attempt a statement of some of the positive inferences that could be drawn from this exposition of weaknesses and the reasons for them.

We may focus on the weakness of the SFCI as financial institutions as the heart of the matter: they should become viable, sustainable operations, covering their costs and collecting their debts. (Others may have different ideas of what is most important among the various intereacting elements in farm credit operations, but this focus appears to this editor a useful way of pulling the elements together.) To avoid financial losses, a lending institution must do two difficult things: 1. charge enough in interest or fees that its income will cover its costs; 2. gain sufficient respect from the farmer-borrowers that they will repay loans unless truly prevented from doing so by adversity.

To charge high enough interest rates on loans requires a clear recognition that small rural loans are by their nature a high-cost activity; they are not lower in cost than lending to richer people in urban areas -- as the village moneylenders have discovered (see preceding article). It also requires governments to recognize that subsidizing low-interest loans to farmers is not a way to solve rural problems in any sustained way. At best, they can introduce a few farmers at a time to new practices by temporary subsidy; but they cannot afford to keep all their poor farmers on indirect subsidy for long (most of it won't reach the poorer people anyhow). So, having confronted these realities, governments ought to put their efforts and resources into launching institutions that will be self-supporting, and/or motivating private banks to serve rural areas more adequately and profitably.

To gain respect from borrowers is a tricky business, harder to prescribe for; different cultures, and situations will no doubt call for differing tactcs. But in all cases the requirement is that borrowers must value what the credit institution can and will do for them (beyond the cash obtained from a first loan). Therefore, specialized farm credit institutions need to examine themselves from a borrower standpoint, and take actions accordingly -- a most difficult feat. In most instances they should provide services better adapted to rural conditions, while also working on cost reduction, and should try to attract savings along with lending. Their technical contributions to farming, where these are associated with credit, must be of demonstrably practical value to borrowers. And their management style must be right -- whatever that may mean locally. These things apply whether credit institutions are public or private, and whether they deal directly with farmers or work through cooperatives or other intermediaries.

These views are the editor's, not necessarily shared in all respects by the U.S. Agency for International Development. They are, of course, stated briefly, and thus may not suggest the complications involved in doing what they call for. The case for striving to do as much as possible can be inferred from the account given in the preceding article of the hazards of starting from inappropriate assumptions and moving in directions where weaknesses grow up, and one problem leads to another. SFCI in many cases seem not well formed for the job they ought to be doing; but while there is a case for their elimination, I am not certain that anything better would necessarily appear in their place. My view would favor reshaping rather than abolition.

Gordon Donald, Editor

Financing Rural Non-Farm Enterprises in Low-Income Countries

Richard L. Meyer

[A neglected element in rural development is the support of nonfarm activities. These have been generally short of capital, among other things; credit institutions should develop more innovative approaches to adapt their services to the needs of small enterprises.]

A number of low-income countries, especially in Asia, are currently placing increased emphasis on off-farm employment as a means to alleviate rural poverty. Although improvements have been made in some countries in rural incomes, there is a growing frustration about the limited impact made by past strategies in materially improving rural welfare. Capital-intensive industrialization has failed to generate significant increases in employment to absorb the available labor supply. Technology-oriented agricultural development strategies have eased food constraints, but the supposed trickle-down of benefits to small farmers and rural workers has been limited. Although some small farmer programs appear promising, most have yet to demonstrate a significant impact on the poverty problem. Their scope has been limited, and it is not clear how far these pilot programs can be generalized to all the rural poor. Policy makers are therefore turning to off-farm employment as an additional measure to improve incomes of farm households.

As development strategy shifts in this direction, a logical question must be: how can the small-scale sector be assisted? In many countries, a viable small-scale sector is dependent upon a

Dr. Meyer is an agricultural economist with the Ohio State University, Columbus, Ohio.

deliberate restructuring of the current rules of the financial game which favor large-scale firms. Once having achieved such a restructuring, however, the question still arises as to what specific programs and policies can be designed to facilitate the creation and expansion of small-scale firms. The purpose of this paper is to review the financial needs of rural nonfarm enterprises and analyze how rural financial markets can better serve these needs.

Off-Farm Work and Rural Nonfarm Enterprises

Before discussing finance, it is useful to briefly summarize some of the recent literature concerning the rural nonfarm sector. Two research themes are most relevant. The first concerns the nature and extent of off-farm work for rural households. At one time, this issue was largely ignored by agricultural economists; part-time farming was seen largely as a transitional phenomenon. Part-time farmers were viewed as a problem in efficient resource allocation, and policy was largely directed toward speeding their adjustment from part-time to full-time status.

More recently, however, the part-time farm household has begun to be viewed with more interest as a possible permanent fixture of the rural setting. In such widely divergent settings as the U.S. and Japan, rural residents typically earn a wide variety of incomes from both farm and off-farm sources. In the U.S. the proportion of farm household income derived from off-farm sources grew steadily from 43 to 59 percent between 1960 and 1976; in Japan this proportion grew from 48 to 62 percent from 1964 to 1975. The importance of off-farm income is much larger for small farms. Over 80 percent of the household income of U.S. farms selling less than $2,500 in gross sales come from off-farm sources in 1976, up from 60 percent in 1960. In Japan, farms with less than 0.5 hectares in 1973 earned almost 90 percent of household income from non-agricultural sources, while that percentage was only 30 percent for farms over 2.0 hectares. And the importance of off-farm work is not limited to high income countries. Farm records, surveys and village studies in such widely divergent areas as Thailand, Taiwan, Korea, Sierra Leone, Nigeria and Egypt show that farm families allocate their time to and receive income from a wide variety of off-farm or nonfarm activities. Problems of rural-urban income gap and rural income distribution would be much worse if low-income rural households did not engage in such off-farm activities.

The second increasing theme found in the literature concerns the nature, extent and potential of nonfarm enterprises in rural areas. In many countries 20 to 30 percent of the rural labor force is engaged primarily in nonfarm work. In Asia the share was reported as 51 percent in Taiwan in 1966, 40 percent in the Philip-

pines in 1970, and 25 percent in South Korea in 1970. One-half to two-thirds of all nonfarm employment opportunities in Asia were found in rural areas and towns. Likewise, small-scale firms, the majority of which are located in rural areas, represent a major share of total employment in several industries. For example, Oshima found for the Philippines in 1961 that firms engaging fewer than ten persons comprised 93 percent of the employment in construction, 94 percent in commerce, 76 percent in manufacturing, 64 percent in transport and communications and 95 percent in services. Several studies that have tried to assess the characteristics of different sized firms suggest important advantages for small-scale enterprises. They (1) are less capital-intensive; (2) are more geographically dispersed; (3) offer more opportunities for unskilled and family labor; (4) have greater linkages with the agricultural sector; and (5) have greater export potential than frequently assumed. It is concluded that expansion of small-scale firms would be more consistent than large-scale capital-intensive firms with the current resource endowments and state of development of most low-income countries. These results lead many persons to argue that more attention should be directed to the small-scale sector. But the question arises, what can be done to assist small-sector enterprises?

Assistance to Small-Scale Enterprises

Most countries employ a variety of industrial promotion techniques including customs exemptions, preferential foreign exchange rates, tax incentives and concessionally priced credit. Unfortunately, these techniques are principally geared to large capital-intensive firms, and small firms frequently do not or cannot benefit. Some promotional efforts must be pinpointed more specifically to their problems. The specific needs and approach will vary from country to country, but a number of options have been suggested:

(1) Infrastructure - Social and economic infrastructure may make a substantial impact on the development of nonfarm activities. Rural areas typically lack communication, transportation, electricity and other facilities. Infrastructure requirements may not be very sophisticated: dirt roads may be adequate, rather than paved highways; diesel generators may serve as well as electrical grids. Small-scale facilities can be more easily located where specifically needed.

(2) Trading services - Small firms frequently lack adequate input and product markets. Healthier cooperatives or trade associations can help in obtaining a steady

supply of lower cost inputs and quality products for domestic sales and exports.

(3) Research and technical assistance - Much of the research in many countries is conducted in urban-based institutes with results that have limited relevance for small rural enterprises. Some of this research could be better located in rural areas, where it would be more directly accountable to intended clientele. Nonfarm extension services could be developed, similar to existing farm extension programs, to encourage the spread of innovations.

(4) Vocational training - A large amount of training occurs in small-scale enterprises through apprenticeships and on-the-job training. Formal vocational training should be complementary, providing basic instruction in management, record keeping, marketing, etc., as well as certain specific skills like baking, welding, carpentry, printing, etc.

(5) Industrial estates - Providing services over wide geographic areas can be prohibitively expensive. Several countries have tried to achieve economies of scale by creating industrial estates. These estates provide infrastructure and facilities, and some even provide building shells for firms. The Indian experience shows, however, that high-cost, poorly located estates will not be fully utilized.

(6) Financial services - Finally, most studies identify credit and other financial services as a constraint and propose credit programs and/or institutions for nonfarm enterprises, frequently in conjunction with technical services.

Existing financial services. The literature clearly suggests that small-scale firms suffer from inadequate institutional financing. Three types of evidence are frequently given in support of this claim. First, small businessmen customarily identify finance as one of their key bottlenecks when asked about their business. In fact, their management of limited capital might be the real problem, or they might think the questioner can help them get funds; nevertheless they frequently perceive that inadequate finance is the major reason for their limited profits.

Second, small enterprises are frequently started and later expand largely with equity capital obtained from savings accumulated from other activities, or from within the firm itself. For example, Liedholm and Chuta report that approximately 60 percent of the funds

used to establish small-scale industries in Sierra Leone came from personal savings from agricultural activities, trade or business. The 1973 Accra manufacturing survey showed that over 90 percent of the firms were started using personal savings or loans from relatives. On the other hand, debt capital frequently plays a more important role in the finance of larger firms in many countries. The limited use of credit by small firms can be seen as evidence of discriminatory credit rationing, especially if it can be determined that the small firms in question are profitable and appear to have potential for expansion.

Third, when credit is used, it frequently is obtained from informal sources (other than friends and relatives) such as input suppliers, purchasers, and moneylenders. The interest rates charged are usually higher than those charged by formal credit sources. For example, Kochov et al. report that small industrial enterprises in Korea borrow at rates of 35 to 40 percent from informal sources, compared to 17.5 percent from official banks, while in Colombia the informal rates are 36 to 60 percent compared to the official 24 percent. Thus, it is concluded that small businesses are denied adequate formal credit and are forced into higher-cost informal sources.

Supply constraints offer one plausible explanation for small amounts of formal credit use. Two other explanations from the side of demand also may be important. Complicated procedures inconvenient or uncongenial to borrowers are often introduced by lenders to assist in rationing scarce loan funds, especially when low interest rates are set. Thus, total costs to the borrower of obtaining small loans are far greater than just the interest on the loan. The supposed large differential between costs for formal and informal credit may largely disappear when total borrowing costs are compared rather than interest rates alone.

For other reasons, too, there may be little demand for bank credit by small-scale firms. The economic environment in which they operate may be so uncertain that there is little incentive for them to grow and expand. Input supplies may be uncertain and of poor quality. Product markets may be easily saturated with increased production. Management may be unqualified to handle a firm of greater size and complexity. In these conditions, assumption of loan repayment obligations may appear unwise.

Determining which of these explanations is most appropriate is a complicated undertaking beyond the scope of this paper. The answer will vary by country and by industry, and firms existing side by side in the same industry may have quite different credit needs so that their demand for credit will be different. There are a number of reasons on the supply side, however, which may explain a limited

amount of credit offered to small firms. By understanding these reasons and working to relax the supply constraints, the demand issues will then be placed in clearer focus.

Factors affecting credit supply. Nonfarm enterprises in the rural areas may suffer from inadequate credit because of the heavy emphasis on farm credit in many countries. It is ironic that the more successful countries are in providing farm credit, the less successful they may be in supplying funds to rural nonfarm firms. Through regulations, quotas, rediscount arrangements, special funds and other means, a number of countries have tried to increase the flow of funds to farmers, and especially small farmers. When these efforts are successful, lenders may spend so much time, effort and funds to meet the farm credit objectives that they have little time or funds left for nonfarm enterprises. Some of these specialized lending institutions are even legally prevented from making nonfarm loans. Furthermore, lenders may experience low profit margins with farm credit, which could discourage them from making small nonfarm loans that may also have low profit margins. Low inflexible interest rates, set by custom or usury laws, contribute to insuring low profit margins.

Farms are heterogeneous, but in specific agricultural regions most farms will likely have broad similarities in technologies and production practices. Thus, lenders can develop procedures and rules of thumb to guide farm credit operations that will be fairly valid within the immediate area. Within that same market area, however, nonfarm enterprises can be expected to vary widely, perhaps including a blacksmith shop, bicycle repair, bakery, tailor, cement plant and textile firms, and there may be only one or a few of each. It is difficult for the lender, therefore, to acquire familiarity with each type of firm and understand their unique problems well enough to feel confident in granting credit and technical assistance.

Lenders generally perceive high risks in small enterprise lending, just as they do with small farmer credit. Small-scale businessmen almost by definition have limited reserves to withstand adversity. Although the small-scale sector may appear to have considerable resiliency as manifested by a wide number of firms, the turnover of firms and bankruptcies are often high. These firms can provide only small amounts of collateral, and the value of such collateral may be low due to the limited market for it in any one area. The success of small-scale nonfarm enterprises may be inextricably tied to the fortunes of farming: when harvests and prices are good, farmers have income with which to pay old bills and contract for new goods and services, but when yields or prices are poor, so is the market for nonfarm firms. Thus, loan repayment will likely follow a similar pattern for both farm and nonfarm firms, so that there will be limited

opportunity for the rural lender to substantially reduce the risk of his total portfolio through nonfarm loans.

The administrative structure of some larger banks works against making many loans in rural areas. Lenders often give little authority to branch staff to make decisions on loans, as these are retained in the home office. The branch staff considers its function largely to collect and channel deposits to urban areas. Little effort is made to aggressively seek out loan customers in rural areas. The expected relationship between collecting deposits from clientele in return for possible loans breaks down, so one of the powerful motives for saving may also be destroyed.

Finally, the operational inefficiencies and attitudes of lenders may exacerbate weaknesses within the small-scale firm. Patel found in a study of innovations used to assist small-scale industry in Gujarat State of India that inadequate working capital from banks was a major problem, even though long-term finance was abundant from state sources. Capacity utilization and sales performance of the new firms studied were much less favorable than projected, due to shortages of working capital. The firms faced long delays in loan approval and disbursement, large margins, inadequate amounts allowed, nonresponse to needs at critical times, and a hardening of lender attitudes at the first sign of trouble. Clearly the banks were not as committed to the small industry promotion program as were the state authorities, and the effectiveness of the other components -- long-term finance, entrepreneur identification and training, and infrastructure development -- was thus blunted.

Directions for improvement. The limited amount of funds going to rural nonfarm firms, and the problems encountered by countries that have tried to increase formal credit supplies, suggest a need to rethink how financial services can be effectively provided in rural areas. Several issues need to be faced. 1) The current emphasis on implementing credit projects rather than strengthening rural financial markets contributes to fragmenting rather than integrating financial services. A few borrowers are favored by a specific project, while many are neglected. Services to firms outside the project may even deteriorate as staff and agencies strive to service project beneficiaries. Rural financial markets must be opened up to a wider range of clientele. Borrowing and savings services must be broadened. Some of the current rules, regulations and requirements must be relaxed, and appropriate incentives given to financial intermediaries.

2) Discussion has focused on the type of institution required to effectively provide financial services to rural nonfarm enterprises, but this issue is probably not worth all the attention

usually given to it. Studies of farm finance show a striking similarity in the performance of various types of institutions in a particular economic environment. The key issue appears to be the objectives and interests of institutions, not their particular form or ownership. For example, Costa Rica, Jamaica, India, and Bangladesh have nationalized commercial banks as a means to alter their performance. Yet studies suggest that these nationalized banks continue to serve approximately the same clientele as they did before nationalization. The nationalized banks tend to share most of the same performance criteria used by commercial banks, such as unit costs, profit margins and surpluses, and efforts to force nationalized banks to make loans which cause these performance measures to deteriorate will be resisted strongly. Fortunately, many countries have a fairly well developed set of intermediaries. The challenge is to develop an appropriate set of incentives so they service nonfarm firms, rather than create new special-purpose institutions.

3) More innovative thinking is required to reduce the cost and risks of lending to small farm and nonfarm firms. Lending procedures need to be streamlined, similar to deposit operations. Risks may be reduced through guarantee funds and loan insurance. Group lending experiments may suggest ways to reduce and improve repayment performance. The advantage of geographic proximity of lender to borrower needs to be more fully exploited in nonfarm lending. The lender can easily make periodic visits to the firm to assist with financial management. Loan repayments can be scheduled differently. For example, a bicycle shop may logically make daily or weekly loan payments which would be impossible for a farmer due to distance and seasonality of income.

4) Increased attention must be given to the terms and conditions of loans. Amortization schedules must be made more flexible. Incentives are required to encourage rapid payments, but simple provisions are also necessary for extending loans and scaling down payments when planned production and sales conditions are not met. Interest rates must be set at rates which reflect the true scarcity of the capital in the society and offer an attractive return to the lender. If temporary subsidies are required for the borrower, it is far better to provide them through means other than concessional interest rates which discourage lenders while encouraging borrowers into a more capital-intensive technology.

5) Training and technical assistance are required for both the lender and borrower. Lenders need assistance in improving loan services to keep pace with the efficiencies obtained by some institutions in servicing deposits. Loan officials need information on the problems and the potential of various rural nonfarm enterprises.

More efficient and knowledgeable lenders should be more inclined to make small loans to nonfarm businesses. The lenders need enough information about various types of firms so loans can be based on projected debt repayment capacity rather than exclusively on arbitrary rules of thumb or procedures. In turn, lenders could provide important noncredit services to borrowers. Most small businesses have little or no record keeping; lenders are logical sources of information for decision making. Indeed, this information might be more useful for the long term survival and expansion of the firms than the credit itself.

[Extracted from Problems and Issues of Agricultural Credit and Rural Finance, Proceedings of an international workshop on financial services to the rural poor, pp. 117-25. Published by the Agricultural Credit Department, Bangladesh Bank, Dacca, 1979.]


LYSOGENY

Laboratory of Quantitative Biology at Cold Spring Harbor, New York, a center for study of subjects like bacterial genetics. (Photo: Cold Spring Harbor Lab.)

Microbiological Science for Development

Carl-Göran Héden

[The exploitation of beneficial microbes, and protection from damage by harmful microbes, have a great importance for human life in all areas. This article describes a new international network designed to help bring the gains from microbiological science to the developing countries.]

Humanity increasingly will have to depend on renewable resources derived from the biosphere it shares with plants, animals, and microbes. The exploitation of domesticated plants and animals has been successfully practiced since time immemorial, but it was only one hundred years ago that we started to learn how to exploit beneficial microbes, and how to defend ourselves against pathogenic microbes. The "domestication" of microbes requires more skill than the domestication of plants and animals, but its benefits are no less. At the moment these are reaped chiefly by the developed countries of the world. Most developing countries have not yet reached the state where they can take full advantage of this important biological research. Out of the 100,000 microbiologists now living, only a small percentage are found in the Third World. Yet applied microbiology is eminently suited to making important contributions to the fulfillment of basic human needs in developing countries.

The UNESCO/UNEP/ICRO Program

UNESCO, the United Nations Environment Programme (UNEP), and the International Cell Research Organization (ICRO) -- a non-governmental organiza-

Dr. Héden is Professor, UNEP/UNESCO/ICRO Microbiological Resources Center, Korolinska Institute, Stockholm, Sweden.

tion -- have recognized how useful applied microbiology could be in the developing countries. This recognition has led them to forge a joint program whose aims are to help advance the growth of applied microbiology in the scientific infrastructure of the developing countries, and to promote development-oriented research activities in the technically advanced countries. The UNESCO/UNEP/ICRO microbiology program seems an appropriate practical model in the context of mobilizing technology for world development because:

(a) It involves the initiation and development of technologies ranging in scale from household to industrial, with emphasis on low-cost, low-energy technologies that are within the economic and technological capabilities of the developing countries. It makes a special effort to stimulate rural self-reliance;

(b) The guidelines followed by the program, developed from practical experience in the field, are in harmony with the principles formulated in the New International Economic Order;

(c) The program directly impinges on both scientific and technological infrastructures in a wide range of disciplines as a consequence of the strong interdisciplinary character of microbiology;

(d) The program's subject matter is restricted to a well defined area of applied biology in which an obvious backlog exists in developing countries.

The Rationale of the Program

Bacteria, fungi, protozoa, algae, and viruses are all microbes, that is, very small organisms a few thousandths of a millimeter in size. Yet their total biomass is estimated to be of the same order of magnitude as that of plants and animals. Much of the activity of microbes is essential or beneficial to human life, but some of it is detrimental. Microbes are the oldest living organisms on earth and may be considered the ancestors of all other forms of life. Because of their special qualities, microbes play an important role in shaping the biosphere and man's place in it. Microbes are the main "pumps" in the cycles of carbon, nitrogen, oxygen, and sulfur, and are thus responsible for the steady composition of the atmosphere. For instance, 30 to 50 percent of all carbon dioxide converted into organic matter is consumed by photosynthetic microbes (in plankton) in the oceans, and some 90 percent of the carbon dioxide brought into the atmosphere is produced by microbes during the degradation of organic matter. If the latter process ever came to a standstill, the carbon dioxide content of the atmosphere would drop to zero within a century and plants would no longer be able to grow.

Thus, microbes are at the root of marine productivity and, at the same time, the main agents responsible for the natural decomposition of wastes. The technology of waste treatment, in fact, is essentially based on an intensification of this natural process by technical means; sewage treatment is the largest microbiological industry in the world. Another example is found in the microbial fixation of atmospheric nitrogen, which is counterbalanced by microbial denitrification leading to the loss of fixed nitrogen from soil and water to the atmosphere. These parts of the nitrogen cycle are of primary importance for soil fertility.

Beneficial microbes have been used unknowingly for centuries in many traditional processes in which food is preserved or altered in quality by judicious, semi-controlled microbial action, as in the making of wine, yoghurt, sauerkraut, and cheese. Many of these processes have been rationalized by the use of pure microbe cultures, or mixtures of selected strains, resulting in the production of an essential part of human food intake. Microbes even play an important role in the production of meat, since plant-eating meat animals depend on microbial activity in the stomach for the conversion of cellulose into essential nutrients. However, many traditional fermentation processes are still being practiced in some countries without the benefit of full scientific control, and hence are still subject to becoming health hazards and causing unnecessary losses in nutritional value.

The importance of microbes in food production has gradually become dwarfed by the rapid growth of the so-called fermentation industry, which over the past five years has successfully embarked on the production of such diverse products as alcohols, organic acids and ketones, amino acids, vitamins, drugs, antibiotics, vaccines, enzymes, and fodder protein (single cell protein). In Japan, for instance, this industry is now responsible for 6 percent of the nation's income. An important characteristic of the industry is that it consumes agricultural by-products which, if unused, would qualify as waste materials. The rising prices of non-microbial protein and of petroleum are now making the industry even more important. Meanwhile, we have also learned that microbes can be used in the control of disease in man, plants, or animals; mass-produced microbial pathogens for the parasite or the disease vector are introduced at strategic points. The environmental advantages of biological over chemical pest control are well known.

One of the major factors limiting food production, and often the chief factor, is the absence of nitrogen. In developing countries where the water supply is adequate, it is often the amount of nitrogen available to higher plants that determines the amount of food that can be produced. In many of the arid regions, lack of

nitrogen is second only to lack of water as the main reason why crop yields are low. In the technologically advanced countries, much of the plant need for nitrogen is supplied by fertilizers. Fertilizer nitrogen is synthesized by the chemical industry; the cost of the fertilizer is low in comparison with the value of the food to the human population. In most of the developing countries, on the other hand, the relative cost of fertilizers is quite high, making it too expensive for small farmers. In many regions fertilizer is totally unavailable.

Microorganisms have a unique role in the nitrogen nutrition of plants. The reason is that some of these organisms carry out essentially the same function as the chemical industry, namely, taking nitrogen from the atmosphere (where it is unavailable to higher plants) and converting it to a usable form. This the microorganisms of soils do at no cost to the farmer, and with very little need for environmental manipulation. In some instances, the addition of selected strains of the nitrogen-fixing genus *Rhizobium* to soils or seeds can replace industrially produced nitrogenous fertilizer. (See Development Digest, October 1975, p. 18.) Promoting the growth of nitrogen-fixing algae can achieve similar ends in rice fields. Actions like these provide important savings in energy and industrial investment and at the same time reduce the pollution of water from fertilizer run-off.

Microorganisms are gaining increased recognition as alternatives to chemical pesticides. Most pest species have natural enemies within the microbial world, and it is known that the activities of microbial pathogens, parasites, and predators can be directed against agricultural pests and thus increase the production of food and fiber. Microbial agents of biological control are a welcome addition to the arsenal of weapons in our war against pests, and they are used increasingly in integrated programs of control.

Waste treatment is now mainly protective, but the more positive approach of turning wastes into useful products is receiving increased attention. Especially in the developing countries, existing processes like sewage farming and fish culture in waste ponds should be improved and made hygienically safe. The use of wastes in the aquaculture of desirable algae or plants is being explored and exploited. The following list of waste treatment processes which employ microorganisms to yield products of potential value is far from exhaustive: the production of fodder yeast on spent liquor from paper manufacture by the sulfite-pulping process; the production of "wheast", a nutritious food substance formed when lactose-utilizing microorganisms are grown on whey, a waste resulting from cheese manufacture; mushroom production on rice straw or compost; methane fuel formed by anaerobic digestion of animal manure or

plant residues; and microbiological processing of cellulosic and starch wastes to enhance their nitrogen content and hence their value as human and animal feed.

The versatility of microbes is clearly demonstrated by their uses in the mining of ores of several metals. Mineral deposits and slag that cannot be economically exploited by conventional mining and chemical methods can sometimes be profitably extracted by microbial treatment. Acid production by specific types of microorganisms has facilitated the mining of low-grade ores of copper, zinc, and uranium, and microorganisms have assisted in the reclamation of oil from shale. Yeast has been used to remove undesired wastes from petroleum by a process which not only increases the commercial value of the fuel but also produces single-cell protein for animal feed.

The current public concern with limitations on the world supply of fossil fuels poses challenging possibilities for the creation of renewable sources of non-polluting energy by microbiological methods. The capacity of microorganisms to produce bio-gas, hydrogen, and methane has attracted particular attention, and several procedures have been developed for the formation of these substances from waste materials. Sewage grown on "energy farms" can produce ethanol obtained from sugar by fermentation.

The various uses of beneficial organisms are far from exhausted. Many new developments can be expected in the next decade as a result of genetic strain improvement by the use of immobilized enzyme technology and other imminent scientific and technological breakthroughs. Microbes play a vital role in the development of biochemistry, molecular biology, and genetics. Their small size and rapid multiplication, coupled with the fact that the entire living world possesses a basic unity, has made microbes rewarding tools for research in these areas.

Harmful microbes manifest themselves most clearly in infectious human diseases. Protective action has been most successful where an understanding of the principles of infection is prevalent in the population and is combined with curative and preventive medical treatment. Many diseases under control in the advanced countries are still rampant in the developing regions of the world. This was strikingly illustrated at the 22nd World Health Organization Assembly, where the delegate of one Asian government stated that waterborne diseases accounted for 60 percent of all morbidity and 40 percent of all mortality in his country. He estimated that 90 percent of the rural population (and 72 percent of the total population) suffered from intestinal parasitic infections, and that less than 10 percent of the total population had access to piped water supplies.

Microbial diseases in plants and animals have called forth defensive management in agricultural and animal farming, the outcome of which has a great impact on the precarious food situation in many parts of the world. Certain foods may contain pathogenic microbes or toxins of microbial origin even though their nutritional value has remained unimpaired. Salmonellae in meat or fish meal, and aflatoxins in peanuts, are examples. Developing countries that lack the microbiological expertise to prevent such contamination therefore cannot export such foods, since they do not meet health standards.

Besides pathogenic microbes, many other microbes can spoil foods and other valuable materials, ranging from wood to stone monuments. Food spoilage deprives the world's population of a large percentage of the world's harvest, and microbial corrosion and other forms of biodegradation cause annual losses in the millions of dollars. Knowledge of spoilage mechanisms and preventive action by canning, refrigeration, and other forms of preservation, as well as chemical protection, has reached a high degree of effectiveness in the developed world, however.

In short, microbes are of vital significance for human survival. The domestication of the microbe has developed relatively recently and is far from complete, even in the developed countries. In contrast to the domestication of plants and animals, that of microbes requires more basic general education, combined with specialized skills not readily transferred by the social mechanisms found in agricultural tradition. Successful handling of microbial strains, or even recognizing them for what they are, requires much more knowledge than growing a crop or raising cattle.

It is therefore not surprising that the developing nations of the world thus far have not fully profited from the microbial resources at their disposal. Through lack of basic education, expertise, and appropriate microbial strains, they are foregoing benefits that are available to the developed world while they remain exposed to the environmental hazards of harmful microbes. Developed as well as developing countries may expect to gain much from future developments in basic and applied microbiology, and developing countries can derive great benefits from the transfer and application of existing knowledge. It is, therefore, imperative that mechanisms be created to provide developing countries with locally useful strains of microorganisms, and with adequate training and research facilities for using them.

Areas of Activity

The UNESCO/UNEP/ICRO program addresses itself to the following main subject areas:

(a) Registration and preservation of the microbial genetic resources of the world, and making them available to developing countries.

(b) The application of microbiological nitrogen fixation (*Rhizobium*, blue-green algae) so as to reduce the requirements for chemical nitrogenous fertilizers. The use of commercial fertilizers promotes eutrophication, and their manufacture requires large amounts of energy. Many countries have to import fertilizers, which requires increasing amounts of foreign currency.

(c) Microbiological methods for the production of food and fodder, including single cell protein as well as indigenous fermented foods. Food preservation and methods to counteract postharvest microbiological food spoilage.

(d) Use of microbes in management of the environment. Water and waste-water purification. Waste utilization and recycling, including bio-gas production and upgrading of cellulose wase by protein enrichment for use as fodder.

(e) Microbiological aspects of health problems in man, plants, and animals occurring as a corollary to microbial waste utilization and food production and the microbiological control of pests and disease vectors.

(f) The use of bio-technology for the full exploitation of available renewable resources at appropriate scales, ranging from the household and village levels to the industrial level, and geared to the promotion of self-reliance in the areas of food, fodder, fuel, and fertilizer, especially in rural areas. Application of appropriate technology and simple diagnostic and measuring equipment (field kits).

(g) Training of manpower and strengthening of infrastructures for research and for dissemination of applicable results on a national and regional basis. Promotion of microbiological societies and two-way interaction with international non-governmental organizations. Stimulation of the interest of decisionmakers and the public at large.

(h) Promotion of the participation of developing countries in international programs focused on global environmental problems in which microbes play an important role, such as the safeguarding of the biogeochemical cycles; for such programs, data from developing countries are required. Due recognition is given to the different priorities that developed and developing countries can give to such projects.

(i) Creation of an awareness of the positive and negative impacts that can be anticipated from scientific breakthroughs in microbiology (e.g., enzyme engineering, genetic engineering).

Methods of the Program

While UNESCO and UNEF provide the program official status, organization expertise, administrative facilities, and basic funding, the ICRO provides scientific guidance -- through a Microbiology Panel whose members are slected for scientific competence and willingness to cooperate actively without remuneration. Rotation ensures both continuity and "rejuvenation", and an increasing number of the panel's members are being drawn from the developing countries. The most important instruments used in the execution of the program are surveys, conferences, training courses, Microbiological Resources Centers (MIRCENs), and coordination activities.

Surveys are conducted to provide an insight into the status of applied microbiology in different geographical regions and also serve to identify persons and organizations capable of serving as focal points for program activities. The Panel now possesses a useful data base for future policies as well as the means to obtain more specific information when required.

Conferences on Global Impacts of Applied Microbiology (GIAM) have an important function in the program. Participants from developed countries (a minority) join their colleagues from the developing countries in discussing a broad spectrum of topics of direct interest to the region in plenary and specialized sessions. Other events range from travelling seminars to training courses; special symposiums dealing in depth with topics of regional significance (e.g., nitrogen fixation, or indigenous fermented foods) often are added to the program. In many cases, microbiologists from a specific region meet one another for the first time during a GIAM conference, promoting future cooperation on relevant regional needs.

About thirty training courses involving over 500 trainees have been held so far in Asia, Africa, and Latin America on subjects involving the major areas of activity. The teaching faculty consists of a few foreign experts who assist in the preparatory work and as many local and regional experts as possible. The study program includes lectures, bench work in the laboratory, evening seminars, and field trips. Additional activities now under consideration are special refresher courses, technician training, and expansion of the existing small fellowship program in conjunction with the MIRCENs.

In 1976-1977 a pilot project was started involving two MIRCENs specializing in nitrogen fixation (Porto Alegre; Nairobi), two

MIRCENs specializing in the collection, preservation, and maintenance of cultures (Bangkok; Cairo), and two auxiliary MIRCENs (Stockholm; Brisbane). These institutes were selected because they were both capable and willing to expand their activities to fulfill an additional regional function with regard to training, research, preservation of cultures of economic importance and, most important, dissemination of cultures and information on how to use them. Some of these MIRCENs have become operational and have engaged in preparing regional catalogues of cultures, directories of institutes, and newsletters. They will become focal points for future training activities of the program.

The Brisbane, Australia MIRCEN comprises the World Data Center on Microbial Genetic Resources, and has special centralized functions, both receiving and disseminating data on all available microbial cultures in the world and assisting in the identification of new isolates. The Stockholm MIRCEN, housed in the Karolinska Institute, provides training support and technical assistance, specializing in the design of simple diagnostic equipment that can be made in the developing countries.

The program has helped promote the formation of regional networks for cooperative research by bringing together scientists who were previously unaware of each other's activities. Numerous personal ties have been forged between scientists from developing and from developed countries, to the benefit of both. The program is expected to make the universities and governments of the developing countries more aware of the importance of applied microbiology which, especially in developing countries, does not receive the priority its potential benefits warrant.

[Extracted with permission from Chapter 18 of Mobilizing Technology for World Development, Edited by Jairam Ramesh and Charles Weiss, Jr. New York; Praeger Publishers for the International Institute for Environment and Development, and the Overseas Development Council, 1979. Copyright© Overseas Development Council, Washington, D.C.]

New Genetic Technologies: Prospects and Hazards

Jonathan King

[This article describes briefly some of the new possibilities opened up by recent discoveries in biology, notably those enabling scientists to combine genes from different species and "redesign" organisms -- including even human beings. Some of the hazards of these new technologies, and the moral questions they raise, are noted.]

During the past 30 years we have witnessed extraordinary advances in knowledge of fundamental biological processes, particularly at the cellular and molecular level. These advances have derived in large part from the major investment of public funds in the training of biomedical scientists and support for biomedical research, conducted by the governments of the industrialized countries since the end of World War II. In the U.S., these programs originated in the pressing need for coordinated bio-medical research to deal with the immense damage suffered by soldiers during and after World War II. The federal funding and encouragement of cooperative, organized research ventures was highly successful and continued after the war.

The well-financed program of training and research has led to: the elucidation of the chemical structure of the genetic material, DNA; the understanding of the organization of the genetic material in linear segments, the genes; the recognition that genes are blueprints for the structure of protein molecules, which form both the building blocks and working parts of cells; the understanding of the roles of the thin membranes that divide cells into different compartments; and enhanced knowledge of

Dr. King is Professor of biology at the Massachusetts Institute of Technology, Cambridge, Mass.

the organization and functions of the complex ribosomes, themselves composed of more than 70 different kinds of protein molecules, which serve as the factories for assembling new proteins according to the instructions of the genes. Thus, the work of tens of thousands of laboratory workers have revealed the extraordinary richness and creativity of the mechanisms by which living things reproduce themselves and interact with their environment.

In the industrialized nations, the major steps in cutting infant mortality, increasing the life span, and controlling infectious disease occurred earlier in this century. These resulted from the improved standard of living - notably the shorter working day, increased wages, and improved working conditions - aided by public health professionals who fought for improved sanitation, water supplies, and food, thereby helping to eliminate cholera, diphtheria, scarlet fever, and other scourges of the urban poor. The more recently acquired understanding of the biochemistry of bacteria and the role of viruses in human disease, and the development of tissue culture technology for growing cells and viruses in the test tube, laid the basis for eliminating a further set of diseases: polivirus infections in the 1950s; rinderpest virus, a major killer of African cattle, in the 1960s; and more recently, the dramatic eradication of smallpox. (Twenty years ago in India alone there were 150,000 cases of smallpox, causing 41,000 deaths.) The elimination of rinderpest and smallpox viruses resulted from campaigns organized and coordinated by the United Nations. The scientific basis now exists for mounting research campaigns against viral diseases such as Rift Valley Fever in North Africa, yellow fever in Central Africa, and hemorrhaggic fever in Asia, as well as such widespread parasitic diseases as schistosomiasis and filariasis, including one of its more tragic forms, river blindness.

Of course, many of these diseases are intimately associated with particular conditions of life -- housing, water supplies and sanitation, and nutrition. Increased knowledge of the biochemistry and physiology of particular organisms does not substitute for the need to study the interrelationships of organisms within ecosystems as well as the social and economic conditions of human society. Smallpox infects only humans, for example, enabling all potential hosts to be identified and vaccinated. Many of the other viruses that affect humans also live in insects or animals and other parts of the ecosystem. These cannot be eradicated by the same strategies used for smallpox.

Another major contribution of modern molecular genetics and cell biology is the recognition that much of human cancer is due to damage by external agents to the genes of human somatic cells. These agents include industrial chemicals such as aniline dyes, which cause bladder cancer, vinyl chloride, which causes liver cancer, and most forms of ionizing radiation. For example, high levels of leukemia

and bone cancer are found among survivors of the Hiroshima and Nagasaki holocausts and among people repeatedly exposed to nuclear testing. Other cancers from excessive medical irradiation and exposure to mismanaged nuclear waste will likely manifest themselves in coming years. These major breakthroughs have led to the recognition among a sector of the scientific community that much human cancer is preventable.

Recombinant DNA Technology

The growth of biological knowledge has engendered the development of very sophisticated biochemical genetic technologies. These technologies, which are today tools for the accumulation of knowledge of organisms, are also the tools for the genetic and biochemical modification of those organisms. The most dramatic and revolutionary of these technologies is recombinant DNA technology, or genetic engineering -- the ability to incorporate segments of DNA, i.e., genetic material, derived from one organism into the cells of another organism. The donor and recipient may be closely related (for example, two strains of bacteria), or they may be very different (for example, a mouse and a bacterium).

Members of the same species exchange segments of genetic material regularly; this is the biological basis of mating and sex -- the exchange of equivalent segments of genetic material of parents, generating new genetic combinations in the offspring, which may prove advantageous in adapting to a changing environment. However, exchange of genetic material between members of unrelated species is rare. Organisms adapting to different environments -- to different niches, to use the ecologists' term -- evolve different "instructions": different genes. Exchange between such organisms is generally not useful, and therefore rarely observed in nature.

Recombinant DNA technology is useful in biological research, however. Suppose I am studying how pancreatic cells produce insulin and why liver cells do not. I might remove the pancreas from a mouse, and extract from the pancreas cells the long, stringly DNA molecules that represent the blueprints for being a mouse. By treating the isolated DNA molecules with a special protein catalyst, the DNA can be cut into shorter pieces, with the cut ends left sticky. Using similar techniques, I can isolate DNA molecules from a bacterium, whose cut ends are also sticky. Usually this bacterium will be one common in the human gut, and called E. coli. On mixing the two tubes of DNA, the sticky ends of mouse DNA will join with lengths of bacterial DNA. Such molecules, containing the genetic material of two different organisms, are termed "recombinant DNA" molecules. These recombinant molecules can then be reincorporated into a living, growing bacterium. When the bacterium divides, it will reproduce its

own DNA, and also reproduce the piece of mouse DNA, or gene. If we isolate the bacterium and incubate it in some beef broth, the next morning we will have 100 billion daughter cells. Each of these will have an identical copy of the mouse gene. Molecular biologists speak of this as "cloning" a mouse gene.

Because bacteria, despite their complexity, are vastly simpler than mouse cells, the techniques of chemistry and biochemistry can be used to study the mouse gene and sometimes the protein whose structure it encodes. From these studies, we might learn about what signals turn this gene on in some cells and off in others. We might also get some hint as to how the genetic information stored in the nucleus of a cell provides the blueprint for the three-dimensional structure and function of the cell. This technology requires no more equipment than is found in a common college microbiology laboratory. Therefore, it is being used in a vast variety of research situations. Furthermore, recently developed techniques make it possible to transfer in the *other* direction to introduce DNA of a bacterium into a mouse cell. Similarly, one can introduce DNA from one species of mouse into another, or transfer small segments of DNA from human cells to mouse cells or other human cells. This technology, developed originally from microbiology and molecular genetics, provides the technological basis for human genetic manipulation. Because of the intense level of research -- hundreds of laboratories are using these techniques to study the genes of animal cells -- experiments labelled "impossible" become routine six months later.

Commercial Exploitation and Biological Hazards

While the scientific community mainly uses recombinant DNA technology as a research tool, private corporations have moved rapidly to construct and market strains of economically or agriculturally valuable organisms and their byproducts. In addition to the activities of small venture firms and most of the pharmaceutical industry, substantial investments have been made by transnational corporations such as International Nickel, Standard Oil, and Imperial Chemical Industries. A well-publicized case in the drug industry is Eli Lilly Corp.'s plan to grow strains of E. coli bacteria containing insulin for sale to diabetics. Strains have already been constructed or isolated that contain the human insulin gene and that synthesize the protein and export a version of it outside the cell. Lilly believes this will be less expensive than its current practice of extracting insulin from the pancreas of beef cattle. The sale of insulin to diabetics is a $100-million-a-year business.

There has been substantial debate over recombinant DNA technology. The debate has centered on whether bacteria incorporating foreign DNA constitute new hazards to humans or to other species.

For example, though E. coli is a normal inhabitant of our intestinal tract, certain strains are the causes of infantile meningitis and diarrhea, urinary tract infections in women, and serious bloodstream infections in hospital patients. In many cases, the pathogenicity of these strains derives from small parasitic DNA molecules which they carry. These "plasmids" confer special properties on the bacteria such as toxin production, and can also be transmitted from bacterium to bacterium. Derivatives of these plasmids are used as carriers of foreign DNA in recombinant DNA technology. If a plasmid coding for insulin was transmitted from a laboratory strain of E. coli to one of the wild pathological strains it could cause additional damage.

To the extent that such strains of bacteria escape into the environment and establish themselves somewhere, they constitute a form of pollution, an unwanted byproduct of technology. But such biological pollution is qualitatively different from other forms of pollution such as heavy metals, oil, and synthetic chemicals. Organisms reproduce themselves and cannot easily be removed from an ecosystem. This self-reproducing potential of the byproducts of recombinant DNA technology is the reason for the special concern of many scientists and the public.

After considerable internal debate and controversy, the scientific community adopted guidelines requiring that recombinant DNA experiments be performed with weakened strains of bacteria unlikely to survive outside the laboratory, and that physical containment procedures be used, making it even less likely that such strains would escape. These guidelines are now referred to as the NIH (National Institutes of Health) guidelines. A few communities subsequently passed ordinances making the NIH guidelines mandatory. However, they do not apply to private industry or non-federally funded research. During 1979 the guidelines were severely weakened by the efforts of a group of scientists actively engaged in the development of recombinant DNA technology in alliance with commercial interests.

Some observers have found it difficult to understand why scientists should be concerned about community-imposed safety standards on laboratory work. However, safety procedures that are a minor inconvenience on work involving 10 milliliters of cells have a very different impact on the production of 1000 liters at the commercial scale. New technologies often result in human casualties. In the case of recombinant DNA technology, we must insist that such costs be reckoned with from the beginning as part of the production process, and not be passed on to an unwilling or unknowing population.

Human Genetic Engineering

The new biological technologies make possible the ultimate modification: the "engineering" of human beings. There is a great deal of research with small mammals such as mice and rabbits, both in introducing segments of DNA into their cells and in analyzing the

DNA by taking pieces out of the cells and cloning them in bacteria. For example, attempts are now being made to remove bone marrow cells (which form blood cells) from an animal and insert into those cells the DNA segment coding for hemoglobin. The cell with the added segment can be transplanted back into the animal. This is a model for gene therapy of inherited blood diseases such as sickle cell anemia and thalassemia. The use of such genetic technologies on human beings will expand in the medical sector far more rapidly than anyone can accurately predict. This will alleviate the suffering of a number of individuals, but will also generate some moral and social dilemmas.

The development of human fertilization in the laboratory by Edwards and Steptoe has vastly increased the potential for human genetic manipulation. One can obtain in the test tube the earliest stages of a human embryo. By introducing DNA, or cells altered in the laboratory, into this embryo and then reimplanting the embryo into the womb, the possibility exists for introducing genetic change in most of the cells of the body -- including the germ-line cells. Thus, changes would be passed on to subsequent generations.

Prior to the genetic manipulation itself, the use of DNA technology to physically analyze the DNA of human cells will vastly increase. Some of this analysis will be used for screening purposes, as in rare cases where the change in the DNA and the relationship to disease is known (in certain rare inherited blood diseases, for example). Instead of examining the blood in the already mature fetus, we will examine the DNA of the cells of the early embryo or the parents.

Researchers will be confronted by the full range of genetic variation among individuals. What constitutes a genetic defect and what constitutes genetic variation? Historically, the value of many genetically determined features such as skin color and hair character were socially determined. What is a defect in one society can be a desirable characteristic in another. At the biological level, the sickle cell trait is considered by some a genetic defect in the United States. But in central Africa it is necessary for survival in malaria-infested areas, rendering the blood cells resistant to the malarial parasite.

<u>Reordering Priorities</u>

We must support every effort to expand and increase knowledge of the functioning of living things and their interactions with the environment, and of the effect of human society on these interactions. This knowledge must be available to all the peoples of the earth and not just a technocratic elite. At present, a number of the most

potent biological technologies are being developed by transnational corporations and research institutions. To select what is needed in a particular area will require very broad biological, ecological, and agricultural education.

In the area of human experimentation and genetic manipulation, we must ensure that the development of very sophisticated technologies for helping a small number of individuals does not obscure the pressing need for eliminating widespread causes of disease and genetic damage. An appropriate form might be task forces on protection of the genetic inheritance from environmental and social damage. This will entail input into the setting of priorities in biomedical research (i.e., what technologies to develop) and not just into the use of technology that is *already* developed. Today we can transplant kidneys, but we cannot prevent kidney disease.

Public health, social ethics, and the problems of underdeveloped rural societies are not the highest priority of experts in molecular genetics and antibiotic production. We must insure the fullest participation of different sectors of society in the development of biological technologies because this is the only way to maximize the social benefits and minimize the risks. We are entering a new era of direct modification and design of organisms. These endeavors will require new social forms and the development of a much higher level of democratic process within the technological sphere.

[Extracted from Technology Review, Vol. 82, No. 4, February 1980, pp. 64-65. Copyright © by the Alumni Association of the Massachusetts Institute of Technology, Cambridge, Mass.]

BOOK REVIEW

NORTH-SOUTH: A PROGRAM FOR SURVIVAL - The Brandt Commission Report. Published by the MIT Press, Cambridge, Mass. 1980 (304 pp. $4.95, in paperback).

Reviewed by Anthony Pearce-Batten
Associate Editor, Development Digest

Early in 1977, World Bank President Robert McNamara suggested in a speech in Boston that an independent Commission be established under the leadership of former West German Chancellor Willy Brandt to study issues and problems of development. In September 1977, Brandt announced the formation of the Independent Commission on International Development Issues. Its task was "to study the grave global issues arising from the economic and social disparities of the world community, and to suggest ways of promoting adequate solutions to the problems involved in development and in attacking absolute poverty". In February 1980, the Commission released its final report, entitled North-South: A program for Survival, after eight meetings held at locations all over the world. The Report represents a consensus view of the Commission's eighteen political and opinion leaders, ten from the developing countries, and eight from the industrialized nations, all of whom served in a private capacity (listed below - p. 128).

Citing increasing dangers to world security, the Report of the Independent Commission on International Development Issues, the so-called Brandt Commission, warns that in the efforts to reduce tensions and resolve the world's economic problems, one major source of instability has been overlooked: the gap between rich countries of the "North" (North America, Europe, USSR, Japan, Australasia) and poor ones of the "South" (Latin America, Africa, the rest of Asia). "The dialogue between North and South will not by itself solve all the world's current problems, but we are satisfied that the world community can have no real stability until it faces up to this basic challenge", the Commissioners conclude. Noting their very different perspectives, "we have all come to agree that fundamental changes are essential, whether in trade, finance, energy, or other fields, if we are to avoid a serious breakdown of the world economy in the decades of the eighties and the nineties, and to give it instead a new stimulus to function in the interest of all the world's people" (p. 31).

In a comprehensive analysis of the economic linkages between industrialized and developing countries, the Commission argues that the mutual gains to be realized should act as a powerful incentive to the industrialized North to adopt its recommended measures to encourage faster growth and development in the South. Development is generally equated with economic growth; industrial and agricultural progress appear to be of equal importance.

The mutual gains among nations constitute a necessary condition for adoption of many policy measures the Report advocates, but these are not an "adequate" incentive for acceptance of all its proposals. "Especially as far as the poorest people and the poorest countries are concerned,the principal motives of our proposals are human solidarity and a commitment to international social justice... It cannot be accepted that in one part of the world most people live relatively comfortably, while in another they struggle for sheer survival. As we shall argue, there are material reasons for trying to end this state of affairs--international political stability, expanding export markets, the preservation of the biological environment, the limitation of population growth. But we speak of solidarity as something that goes beyond mutual interests" (p.64).

Both North and South must begin working toward a "rational and equitable international economic order" the Report states, which will permit the full participation of all countries and self-sustaining growth by the developing nations.

The World According to the Brandt Commission

The Report presents a view of the world which summons the developing countries from deep within the wings onto center stage. In its emphasis on both mutual gains and shared dangers, the Report elevates the art of "interdependence analysis" to new heights. Indeed the combined threats of hunger, poverty, resource constraints and environmental degradation to global security have the effect of expanding the list of mutual gains far beyond the trade, commodity and other economic advantages which are usually cited. In this way the Brandt Commission forges links between its explicit objectives - to encourage faster economic growth and the expansion of world trade - and the wider task of overcoming the worst aspects of poverty by the end of the century. The economic benefits, in terms of increased efficiency plus the mutual losses averted, outweigh the substantial costs in additional aid which such an undertaking will require, in the Brandt Commission's view. The Report goes further and argues that "there are interdependencies not only between countries but between issues". The Commission's exhaustive list of recommendations is based on its identification of the "numerous interconnections" between the various priorities on the global agenda.

Interdependence Among Countries

One country's economic growth is increasingly dependent upon the economic performance of other countries, the Commission observes almost at the outset of the Report, and this linkage pertains with as much validity to economic relations between developed and developing countries as it does to relations within each group. "The South cannot grow adequately without the North", the Commission states. "The North cannot prosper or improve its situation unless there is greater progress in the South". Evidence of this economic linkage is the role of the developing countries in cushioning the blow of the 1973-75 recession on the industrialized countries by continuing to buy Northern products with borrowed funds. The Report cites an OECD study relating the effect of continuing Southern demand to some 900,000 jobs in the industrialized countries annually between 1973 and 1977.

Effects such as these serve as the rationale underlying the Report's call for sharp increases in the flow of resource transfers to the developing countries. Such transfers would serve to encourage growth at a time when the industrialized countries are experiencing substantial under-utilization of capacity, and to stimulate trade and, therefore, the most productive industries in developed and developing nation alike. How much growth? Quoting the OECD again, the Report cites annual increases of 3 per cent in OECD exports to the developing countries over three years as a consequence of $20 billion in increased aid flows in each of those years. Such flows are all the more necessary in view of the possibility that private sources of finance will dry up as the payments deficits of the developing countries increase with rising oil prices. Between 1973 and 1978 debt grew 2.5 times as fast as exports for more than half the oil-importing developing countries, the Report observes, putting pressure on many major banks to restrain lending to them. Without corresponding increases in official bilateral and multilateral lending, such a reduction in the flow of private funds to the Third World would slow economic growth.

Not surprisingly, The Report deems the current trend toward protectionism in the industrialized nations "one of the great enemies of recovery". Citing a large Northern surplus in the trade of manufactured goods, the Report warns: "In the end, the failure of the mature industrial economies to adjust to the realities of international competitiveness may deprive them of their prosperity and impose far costlier and more disruptive adjustments than those which their current measures of protection attempt to postpone". Apart from clothing and textiles, the negative employment impact on the OECD countries of their imports of Third World manufactures has been small, the Report observes, citing several studies to that effect, while offering important anti-inflationary benefits. At the same time, the possibility of further trade restrictions dis-

courages new investment in the developing countries.

One area thought to be in need of adjustment is raw materials, where the Commission supports price and earnings stabilization, and the location of more processing industries in the commodity-exporting countries. Among the price stabilization measures which the Commission supports are the Common Fund, and International Commodity Agreements. Compensatory financing should play a larger role in stabilizing earnings. The removal of Northern tariff structures which discourage the importation of products in manufactured form as opposed to primary commodities would serve to increase Southern export revenues which could be used for other developmental needs.

The Report makes several recommendations to intensify the search for oil in the developing countries, as well as the search for non-oil alternatives, and these too are clearly in the interest of North and South alike. Other areas of mutual gain include environmental conservation, and efforts to increase agricultural productivity in the developing countries.

"A very substantial mutual interest lies in harnessing the economic strength and experience of the multinationals for development", the Brandt Commission observes, provided that the costs and disadvantages to the South of the multinational corporations' activities can be "regulated". Such organizations can provide the capital and the expertise to assist in development of minerals and other resources, including fuel exploration and development.

"We do not suggest that the measures we propose are without cost to the North", the Brandt Commission states. "The North must share its resources and its control of institutions; it must be willing to work for some changes in the way markets operate, which is presently to its advantage. But we do suggest that the North as well as the South gets much in return, both in straightforward economic benefits, and in a reduction of uncertainties and instability".

Issue Interdependence

The Report seeks to present a picture of the world which goes beyond a "piecemeal treatment" of North-South issues, in the words of the Commissioners. They conclude their chapter on mutual interests by urging acceptance of their recommendations, not merely because of their intrinsic value but because "they contribute importantly to each other.....Mineral problems, for example, cannot be fully resolved without action on the financial front, on the issues affecting the multinationals, and in the field of commodity agreements. The energy question requires action in these areas, and also a broader framework

of international agreement. Debt, the international banking system, commodities, and access to markets for manufactures are closely interrelated".

The Brandt Commission identifies similar linkages between its growth and welfare objectives, and by so doing articulates a perspective in which welfare measures contribute to the long-run efficiency of the international economy.

The Commission's treatment of the poorest countries is a case in point. Growth and welfare means and objectives are closely interrelated. On the one hand the long run objective underlying the Report's proposals is to extend the web of trade and financial links to include the poorest countries upon their attainment of the threshold of self-sustaining growth. Such an objective will require sharply increased flows of concessional assistance. A second goal is to eliminate the worst aspects of world poverty by the end of the century. "We emphasize that human needs can only be met by the productive efforts of the society which strives to meet those needs," notes Willy Brandt in his introduction. "The only way to make this possible for developing countries, particularly the poorest ones, is for them to build up and develop their own productive capability".

The Report identifies agriculture as the poorest countries' top priority. To avert a 20 million ton food shortfall by 1990--a third of consumption in those countries--water control and crop management are considered the top priority for attaining improvements within agriculture. Other measures include the provision of basic health services, and the elimination of such diseases as river blindness, sleeping sickness and bilharzia which pose a barrier to the cultivation of large arable areas. Intensive afforestation efforts (as appropriate), greater mineral exploration and development, and more regional cooperation are also features of the Commission's recommended aid program for the poorest countries.

The combined food shortfall for all the developing countries as reflected in net imports, which are projected to increase from 80 million to 145 million tons between 1978-9 and 1990, makes increased agricultural output a major priority the Third World over, the Commission observes, stressing a theme often heard in development cicles. What is different about the Brandt Commission's assessment is its emphasis on non-agricultural progress as part of the solution to the Third World food problem. "Not only must the food be there", the Report notes, but "people who need it must be able to buy it". Internal measures to improve output, including agrarian reform where necessary, need to be supported by increases in external assistance--estimates vary between $4 billion and $8.5 billion annually in addition to the existing $3 billion a year--throughout the 1980s. Interna-

national food security should be guaranteed by establishing the International Grains Arrangement, with larger emergency food reserves and a food financing facility. Food aid remains important, the Commission observes, when it does not weaken production incentives. Added support for international agricultural research institutions is a further necessity, the Report notes.

But part of the effort to promote agricultural development should be to generate income in whatever may be the most productive sectors of developing countries, the Report argues. "Neither food aid nor an emphasis on agricultural development will succeed in the conquest of hunger". The growth of employment in non-agricultural productive activities is necessary to increase the effective (monetary) demand for food. Export-oriented industrial development is necessary to provide foreign exchange for the importation of farm equipment and fertilizer. The availability of purchasable consumer goods provides additional production incentives for farmers. The potential for rapid growth is much greater in the manufacturing than in the agricultural sector. "So the problem of hunger connects clearly with the rest of the Report", the Commissioners conclude. "The expansion of trade and finance, including co-operation among developing countries, which can permit incomes to rise is as important as producing more food or distributing incomes. The low-income countries need assistance both for rural development and for raising the entire productive capacity of their economies which alone can create adequate income and jobs. There are no shortcuts to eliminating hunger".

A similar linkage ties success in stemming the growth in population to development. "What is done to meet the challenges of poverty, ill-health and hunger is a primary contribution to checking excessive population growth", the Commission notes. "In the final analysis, it is development itself that will provide the most propitious environment for stabilizing the world's population at tolerable levels. In the creation of that environment, all countries have a mutual interest. The prospect of an overcrowded planet in the next century has little meaning to people who live on the margin of existence today".

The Task of the Developing Countries

"No examination of international development issues can be realistic without a full appreciation of the essential tasks which developing countries must themselves undertake in pursuit of real development", the Report observes. Such obligations, which should not be regarded as conditional on Northern concessions on international economic reforms, include social and economic programs

to redistribute incomes and resources and reduce poverty within countries, provision of social services, with more economic cooperation between developing countries. These countries are also responsible for achieving increases in agricultural support. The efficient administration of aid funds and improved planning are also cited.

An additional responsibility of the developing countries is, in the Brandt Commission's view, to contribute to a more stable investment climate. The report advocates fair compensation for nationalization, and increased U.N. technical assistance to the poorest countries in negotiating investment agreements with multinational companies.

Other Proposals

Transnational Corporations and technology transfer would be subjected to effective national laws and to an international code of conduct. Both host and home countries would have reciprocal arrangements covering foreign investment, technology transfer, and repatriation of the proceeds. The Report urges intergovernmental cooperation in such matters as taxes and transfer pricing. The poorer countries should receive technical assistance in negotiating agreements with transnational corporations. All countries would retain permanent sovereignty over their natural resources.

The Report proposes several international monetary reforms. The Report supports creation of an IMF "substitution account" to replace national currencies with SDRs (Special Drawing Rights) as the primary reserve currency. New SDRs would be created to increase world liquidity but in a noninflationary way; the distribution of new SDRs should favor those developing countries with adjustment problems.

The Report also endorses a new approach to development finance, along with action on several older approaches. For example, it urges adoption of the UN aid target of 0.7 per cent of GNP by the industrialized countries, rising to one per cent by the century's end. New ideas include "an international system of universal revenue mobilization, based on a sliding scale of national income from which only the poorest countries would be exempted; taxes on international trade and weaponry; and exploitation of the "global commons, especially seabed minerals" These new revenue sources would contribute to development funds; the report does not explore how such taxes would be imposed and collected.

This new approach also incorporates several major reforms in the way that the international financial institutions do business.

The World Bank should double its gearing ratio (the ratio of its permitted borrowing to its capital) from 1:1 to 2:1, raising its borrowing capacity from $80 billion to $160 billion. More development funds should be channelled through the Regional Development Banks. The remaining portion of the IMF's gold should be used as collateral in increasing the flow of development finance to middle income countries, or sold to provide an interest subsidy to the poorer countries. The Report urges more responsiveness by the IMF and World Bank to the problems faced by the developing countries, and more Third World influence over their day to day operations. To fill some of the existing gaps in development finance, particularly the developing countries' program lending needs, the Report urges the establishment of a new institution. This World Development Fund would distribute the new revenues raised from the levies proposed by the Report, would stress program lending, and would have its decision making "shared evenly" by borrowers and lenders.

Other features of the Report's development finance proposals include more finance for mineral exploration and development, increasing maturities on multilateral debt, and assistance in placing bonds of developing countries in international markets through a collective guarantee system.

An Emergency Program

In the Brandt Commission's view, the world cannot wait for its various suggested policy measures to be widely adopted and to take effect, and the Report proposes an emergency program with the following features in response to the most pressing needs.

Resource Transfers which would include an increase of concessional aid to the poorest countries of $4 billion annually, and increased non-concessional lending to the middle income countries.

Energy - an accord between energy producers and consumers assuring security of supplies, more conservation, and efforts to reduce the economic impact of price increases. The industrialized nations would commit themselves to more ambitious conservation targets and, together with oil producers, would agree on their respective roles in recycling OPEC surpluses to the developing countries.

Food production assistance would increase by some $8 billion annually (including part of the $4 billion to the poorest countries). The Report urges an early

conclusion to the International Grains Arrangement, and increases in emergency food supplies.

International Economic Reforms include adoption of many of the Report's development financing proposals, including estblishment of the World Development Fund and use of IMF gold. Other measures urged by the Report include trade liberalization, and more efforts to increase food production and to reduce income inequities by the developing countries themselves.

As a first step toward implementation of these proposals, the Report calls for a summit conference of world leaders.

An Assessment

Perhaps the most striking feature of the Brandt Commission's Report, apart from its comprehensive treatment of development issues, is its warning that resolution of North-South differences and issues is a precondition for defusing the dangerous period in which the international system finds itself. The effect is to project the needs of the developing countries into the center of the action, from their usual position in the chorus of voices vying for the attention of policy makers in the industrialized nations. The Report's identification of the shared interests between North and South amounts to a major extension of the mutual gains thesis.

It is simplistic of course to infer that the Commission's vision of the world could only proceed from the mind of a person of Willy Brandt's stature, one who earned distinction by looking in a new way from West eastward to the Soviet Union, as he now shifts in perspective from North to South. This would do a great disservice to the energies and efforts of the Commission's other distinguished members. Yet such a view pervades the Report's analysis, and reorders in a new configuration the various more or less well-known events that collectively amount to the North-South dialogue. While there is little that is new in the Report in terms of the evidence and data it cites in support of its various contentions, many of its policy prescriptions and the sweep of its world view are bold and imaginative, and somehow characteristic of Willy Brandt. And the clarity of the Commission's perspective on world issues contrasts with the vaguely worded concepts which enshroud most such international and Committee-written documents.

To be sure, the Report has its shortcomings. Left entirely to themselves, goes one of the initial premises of the Report, economic forces tend to produce growing inequality between and within nations. This premise is not restated elsewhere in the Report nor developed further, and in any case is open to question. The remarkable

performance of several developing countries in closing the international development gap, while also establishing greater internal economic equality, countries whose economies are characterized either by lack of government intervention or by a form of intervention designed to accentuate growth rather than increase welfare, casts doubt on this assertion. Within countries, it is arguable that interventionism has contributed to growing inequalities.

Several of the Report's shortcomings relate to its perceptions of mutual gain, just as many of its strengths do. The issue of commodity price stabilization and the benefits it offers the industrialized nations is a thorny one and the Report tends to gloss over the major difficulties. One of the major obstacles, for example, in negotiating commodity agreements has been price. The Report's answer? It should be "remunerative". Another example would be the proposed international tax on arms transfers, which presupposes among other things an improbable degree of openness in arms transactions. In addition, the Report has a propensity to advocate a wider role for international agencies without indicating, in some cases, how this would be beneficial - in contrast with deprecatory remarks elsewhere in the Report about the proliferation of international meetings and organizations.

Perhaps the main comment that can be made on this bold and sweeping approach to the world's problems is not so much that it is careless with details (it would be hard not to ignore many of these in such a globalistic undertaking), as that it assumes a level of international will to accept its objectives that is equally sweeping. National self-interest is a powerful common denominator among countries. So many of the Report's objectives - high aid levels, agreement on international food reserves, monetary reform, etc. - have been put forward and encountered obstacles stemming from national interests that these cannot be forgotten in any realistic assessment. But perhaps the world is in need of a prophetic vision that can rise above short term realism.

<u>List of Members of the Independent Commission on International Development Issues</u>

Chairman: Willy Brandt (West Germany)

Abdlatif Y. Al-Hamad (Kuwait)
Rodrigo Botero Montoya (Colombia)
Antoine Kipsa Dakoure (Upper Volta)
Eduardo Frei Montalva (Chile)
Katherine Graham (USA)
Edward Heath (UK)
Amir M. Jamal (Tanzania)
Lakshmi Kant Jha (India)
Khatijah Ahmad (Malaysia)
Adam Malik (Indonesia)
Haraki Mori (Japan)
Joe Morris (Canada)
Olof Palme (Sweden)
Peter G. Peterson (USA)
Edgard Pisani (France)
Shridath Ramphal (Guyana)
Lavachi Yaker (Algeria)

☆ U.S. GOVERNMENT PRINTING OFFICE: 1980—310-928/3

In Africa, Asia, and Latin America, the DIGEST is distributed through the U.S. Agency for International Development to persons with a professional concern with the development process. Requests for copies should be directed to the AID mission or, if there is no AID office, to the U.S. Embassy.

Readers in North America, Europe, Japan, Australia, and New Zealand, may purchase the DIGEST from the U.S. Government Printing Office. An annual subscription (4 issues) is $7.90 in the U.S., $7.90 plus $2.00 mailing charge elsewhere. Single copies are $2.00. A discount of 25 percent is offered on purchases of 100 or more. Subscription order, enclosing payment, should be sent to:

Superintendent of Documents
Government Printing Office
Washington, D.C. 20402